1129

No. 3081

United States Circuit Court of Appeals

For the Ninth Circuit

MINERALS SEPARATION, LTD., ET AL,

Appellees,

vs.

BUTTE & SUPERIOR MINING COMPANY,

Appellant.

Transcript of Record

Volume 5

(Pages 2197 to 2868, Inclusive)

UPON APPEAL FROM THE UNITED STATES DISTRICT COURT FOR THE DISTRICT OF MONTANA

McKee Ptg. Co., Butte, Mont.

In the ~~Circuit~~ District Court of the United States, Ninth Circuit, District of Montana

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Minerals Separation ~~Company~~, Limited, a Corporation, *Plaintiff*, *vs.* Butte & Superior Mining Company, a Corporation, *Defendant.*	No. 8 In Equity.

BEFORE:

HON. GEORGE M. BOURQUIN, Judge Presiding.

APPEARANCES:

For the Plaintiff:

Henry D. Williams, of New York.
Odell W. McConnell, Esq., of Helena.
L. M. Garrison, Esq.
William Houston Kenyon, Esq.

For the Defendant:

Messrs. Kremer, Sanders & Kremer.
Messrs. Sheridan, Wilkinson & Scott of Chicago.

BE IT REMEMBERED, that the above entitled cause came on regularly for hearing in the above entitled court on Monday, April 16th, 1917, at 10:00 o'clock a. m., before the Hon. George M. Bourquin, Judge Presiding, the plaintiff being represented by its attorneys, Henry D. Williams of New York, Odell W. McConnell of Helena, L. M. Garrison and William Houston Kenyon, both of New York, and the defendant being represented by its attorneys, Messrs. Kremer, Sanders & Kremer, and Messrs. Sheridan, Wilkinson & Scott of Chicago.

WHEREUPON the following proceedings were had and done, to-wit:

Mr. Williams:

If your honor please, I will state to counsel for the defendant, that prior to proceeding with the trial of the suit of Minerals Separation, Limited, against the Butte & Superior Mining Company, counsel for Minerals Separation, Limited, desire to close up the suit against Hyde, which your honor will remember was argued in this court some four years ago, and has passed on to the Supreme Court of the United States, and the Supreme Court of the United States has substantially affirmed your honor's opinion, and the mandate of the Supreme Court of the United States has been returned to this court, and I believe upon the mandate of the Supreme Court of the United States an interlocutory decree has been entered according to the mandate, that interlocutory decree amending the original interlocutory decree by eliminating claims 9, 10 and 11 of the patent

sued and found invalid, and containing statements pursuant to the decree and the mandate of the Supreme Court that claims 9, 10 and 11 are invalid. Now, since the mandate of the Supreme Court, which was issued on the 13th day of January of the present year, consideration has been given to the finding of the Supreme Court that the patent in suit should be confined to the results obtained by the use of a fraction of one per cent of oil, pursuant to the specification of the patent. The Supreme Court of the United States had before it the entire patent, and the Supreme Court stated that the patent should be so confined, and for the purpose of so confining it, adjudged that claims 9, 10, 11, which were before this court, were invalid.

In order to follow the letter and substance of the Supreme Court decision, in order to limit the patent to the results obtained by the use of a fraction of one per cent of oil, the patentees have filed in the Patent Office a disclaimer of claims 9, 10, and 11 as drawn.

Now in the Hyde suit, the final decree which we have prepared for the purpose of terminating that suit, recites the fact that that disclaimer has been filed in the Hyde suit, (and that disclaimer is of record in this court), and the final decree further states that the plaintiffs have withdrawn claims 9, 10 and 11 from the Hyde suit; and the fact then appearing in the record in the Hyde suit that a disclaimer has been filed during the suit, the final decree will be without costs. That is the form of the final decree I have handed to defendant's counsel, and I ask that it may be settled now. The

disclaimer is on file in this court; Mr. Walker has it, I believe, and it is now offered for filing. We now file this disclaimer in the Hyde suit.

Mr. Kremer:

To the filing of the disclaimer we object for the reason that the disclaimer itself is not the statutory disclaimer and does not substantially comply with the statute—the statute requiring a disclaimer in whole, and the disclaimer here presented upon its face being only a disclaimer in part; and for the further reason that the disclaimer was not filed within the time or in manner specified or provided by Section 4917 or Section 4922 of the Revised Statutes of the United States; for the particular reason that the plaintiff has been guilty of unreasonable neglect and unreasonable delay in filing the said disclaimer. In connection with this ground I might add as part of the ~~motion~~ objection that the Supreme Court of the United States, on the 11th day of December, 1916, decided the case of Minerals Separation, Limited, and another, vs. James M. Hyde, and from that time until the 28th day of March, 1917, the complainant failed and neglected and negligently and unreasonably delayed in filing its disclaimer, and this, under the decisions of the Supreme Court of the United States, is not a compliance with the statute so as to take complainant out of the exception of the law, and by failing to file such disclaimer the patent becomes void, and is now void, and they cannot now have a decree entered on something that is entirely void. Under the language of the disclaimer it is a re-issue of the patent they are asking for.

The Court:

Does this section of the patent law cover a mere ambiguity in the specification, a specification true in some particulars, but which may be partly untrue.

Mr. Kremer:

It covers that—the language of the statute is clear. I take it that counsel will agree that if we will consider that the statement of Judge Story is correct, that in the absence of these two sections, 4917 and 4922, the patent would be entirely void, and these sections were enacted solely for the purpose of giving the patentee an opportunity to avoid that which common law has enforced upon him as a penalty, an absolute invalidity, and that would apply in this case, because this disclaimer is not a disclaimer within the meaning of the statute. It is not a penalty imposed on the patentee; it is a benefit that the law extends to him which otherwise he would have been deprived of. But the statutes say to him "You can revise your standing upon the theory that you comply with the terms of this statute," which we maintain they have not done. So for that reason we object to the filing of the disclaimer, and if the decree is now offered with it, we object to the filing of the decree.

Mr. Williams:

I will hand your honor also the proposed final decree. I wish first to say that as to the question of our delay, the statements that I made as to the date of the issuance of the mandate was exactly true. In the Supreme Court of the United States an opinion is given. The opinion is published for a period of 30 days; during

that period it is open to counsel to make any motion that they seek for a rehearing or a reshaping of the form of the decree, and while the decree of the court is given as of the date of the opinion, (here December 11th, 1916,) and is in the possession of the clerk of the Supreme Court, it is subject to revision or alteration for a period of 30 days, and it absolutely has no force and effect until that period of 30 days has expired; then it becomes a decree of the Supreme Court of the United States, and upon it the mandate is issued, and on January 13th, 1917, this year, the decree in the Hyde case became effective and the mandate issued; so any charge of delay against this British corporation is based upon the fact that three months ago this British corporation was informed that there was a flaw in its patent, and that as the patent existed three of its claims were not in their terms confined to what the Supreme Court said was the invention. The British patentee gave the matter careful and thoughtful consideration, and in fact the disclaimer was filed on March 6, 1917, a little more than two months after the Supreme Court of the United States had finally adjudicated the fact that the patent as it stood, in these three claims, was not confined to the results obtained by the use of a fraction of one per cent of oil.

The Court: Is this the case of a disclaimer?

Mr. Williams: Yes; the patentee in claims 9, 10 and 11 claimed more than he was entitled to.

The Court: The statute says "claims more than he discovered." That is a mere ambiguity. Is that claiming more than he is entitled to under the statute?

Mr. Williams: Yes, sir.

The Court: Has the Supreme Court ever said that?

Mr. Williams: Yes, sir, the Supreme Court has said that in several opinions.

(Argument.)

The Court: In any event the court is bound to enter a decree in conformity with the mandate of the Supreme Court of the United States. What effect that will have will be hereafter debated. At this time the disclaimer is ordered filed and it will be allowed to be filed and the decree be signed in accordance with the mandate.

Mr. Kremer: Your honor will permit the noting of an exception upon the record?

The Court: Let the exception be noted.

Mr. Williams: Now, if your honor please, in the case against the Butte & Superior Mining Company—

Mr. Kremer: Before you proceed, we offer an amendment to the answer.

Mr. Williams: We object to the entry of this amendment and —

The Court: Let me hear what the proposed amendment is first.

Mr. Kremer: The amendment sets forth additional patents which the defendant claims anticipate the patent in suit and also sets up certain publications, one of the Daily Herald Democrat—one—the one of importance, the California Journal of Technology; that is the

only one that was not mentioned in the prior answer filed in 1913. This was discovered after the trial of the Hyde case originally, and was a matter that was in evidence and was given consideration in the so-called Miami case. That briefly states the substance of the amendment, although the anticipating patents are enumerated there. I offered them for filing.

Mr. Williams We object to the amendment. The objection is based upon what we shall show. The Butte Superior Mining Company was the actual party defendant in the Hyde suit. It paid all the expenses of that suit; it controlled the conduct of that suit; and in that suit, although with concealment, litigated with the plaintiff the question of the validity of this patent suit. The Butte & Superior Mining Company has therefore had its day in court, and the Butte & Superior Mining Company is bound by the adjudication in the Hyde suit, and no defense additional to what was put forward in the Hyde suit can now, at this late date, be put forward by this defendant, who has already had its day in court. Of course we have not yet brought to your honor the evidence establishing that fact. The evidence has been carefully concealed for some five years, and when it is brought to light, then we maintain that no further defense can be added in this second effort that the Butte & Superior Company is endeavoring to have litigated again, questions that have been litigated to final decision and final decree. We claim of course that these matters are *res adjudicata*. If we establish *res adjudicata*, then further defenses can not be pleaded or considered.

The Court: At this time the admissibility of this

amendment will be held in reserve, and it will be ruled on in plenty of time to give you the benefit of it.

Mr. Williams: There is just one more point that I think perhaps I would like to state here for the record. There is no showing of diligence in the filing of this amendment. The defenses here interposed have been within the knowledge of the defendant for a substantial period of time, and the defendant has not shown the diligence which is required in presenting further defenses.

Mr. Kremer: In that connection you surely do not claim surprise after having these matters litigated in the Miami case for nine weeks; in fact you can not complain of our lack of diligence.

Mr. Garrison: That is an admission that you were in the Miami case; we are very glad to know that.

Mr. Williams: Now, if your honor please, in November, 1913, we first came before your honor in this litigation on a motion for preliminary injunction to restrain the Butte & Superior Mining Company, pending the trial of the suit. The matter was very fully considered by your honor. Affidavits were filed and testimony was taken in open court, and the various questions presented were argued, and your honor found that a case of infringement had been made out, and your honor, in lieu of an injunction, or as a means of saving the defendant from the issuance of an injunction, provided for the filing of monthly reports, and filing of a bond for $75,000, which now becomes a very insignificant fraction in view of what the monthly reports have shown. We also then presented to your honor, as well as we could with the knowledge that we

then had, the question of *res adjudicata,* and upon the evidence that we then were able to get we did not convince your honor that the Butte & Superior Mining Company was bound by the decree in the Hyde suit; in the course of that proceeding the entire record of the Hyde suit was offered in evidence, and the defendant objected to its offer in evidence unless it should be offered for all purposes, for use at each hearing and for use at the trial, and with the same force and effect as though all the witnesses had testified in the present suit. Thereupon the offer was thus amended and the record in the Hyde suit was put in evidence for all purposes in this suit, and is now a part of the record herein. In that record it appears that James M. Hyde, formerly an employe of the plaintiff, while in the employ of the plaintiff, was directed to go to Butte, Montana, and endeavor to bring about the adoption of the process of this patent by the Butte & Superior Company, which was in difficulty in the treatment of its ore; and our trusted employee, Mr. Hyde, replied by stating that his contract with us had nearly expired, and that he would go to London; and instead of going to Butte he came to London and severed his connection with the company. Shortly thereafter—he severed his connection in February or March, 1911—shortly thereafter he came to the United States—came to Butte, Montana, came to the defendant, Butte & Superior Mining Company, offered to them the knowledge that he had acquired and the training that he had received from us, notwithstanding the fact that our representative was here and requesting the Butte & Superior Company to take a license; succeeded in prevailing

upon the Butte & Superior Company to make a contract with him or to permit him to install the infringing process, which was installed, as he states, in August, 1911, and which has been used by the Butte & Superior Mining Company since that time with great profit to itself, in defiance of the patent. In that suit it appeared that when this defendant, James M. Hyde, was asked who was paying the expense of the other suit, he put forward that beautiful explanation—I am paying the expense of this suit with the proceeds of the sale to the Butte & Superior Company of an exclusive license in the Butte district under my patent—which was issued some time after the suit was commenced. The great expense of that litigation, a wholly uncertain quantity, according to Hyde, was to be paid out—not by the company—but by him. That was the consideration for the transfer to the company of this extremely restricted interest in a certain patent that James M. Hyde claimed to have. We proved in that case that this patent was a sham and a fraud; that it was founded on two things, one of which he had learned while in our employ, and the other was a known fact before. It was a perfectly worthless patent. The evidence shows it.

We shall prove, if it is possible to do so—if it is possible to bring out from concealment the real facts of the relations of James M. Hyde with the Butte & Superior Company—that the first installation, which Hyde in that suit admitted was his—was in fact erected with the funds of the Butte & Superior Company at the plant of the Butte & Superior Company, operated

by the Butte & Superior Company, and that Hyde was a mere salaried employe of the Butte & Superior Company, with possibly some contingent interest coming to him in the event of success. We do not know all the facts which we shall try to bring out.

Now, the questions at issue have been litigated—litigated to the end. The Supreme Court of the United States has spoken. There is just one new point of law in this case. There can be no new defenses, because that litigation is over. There can be no attack upon the validity of the patent, because that has been adjudged. But there is the new point of law, and that is the point of law which arises as to the disclaimer. Before the Supreme Court of the United States, claims 9, 10 and 11 as they existed in the patent, included within their scope too much. There was not a word in that specification from beginning to end up to the claims that was in the slightest degree objectionable or capable of criticism. The disclosure of the invention was complete and claims 1 to 8 and 12 were claims which were each one limited within the scope of that invention, but in these claims 9, 10 and 11 the patentees had not put the definite limitations to the invention that they disclosed and claimed in the other claims, and so the Supreme Court held that these three claims were in doubt: the patent must be restricted, and the plaintiff, giving the matter the mature thought and consideration, decided that under the law the proper way to restrict it and to be within the letter and substance of the Supreme Court decision was to file a formal disclaimer, which has been filed; and of course that is a new ques-

tion of law remaining for adjudication in this case, apparently raising only the question as to whether or not the limitation that has been imposed upon the scope of those claims by that disclaimer has now validated those claims within those limitations.

The Court: Is it a case where a disclaimer is necessary? The court will take the liberty of doubting it until I hear you further—as limited by your disclaimer are they in addition to your other claims?

Mr. Williams: We think they were not exactly proper, and that is why we filed the disclaimer. It was a question for serious consideration. It seemed to us that a claim which said that you put in ore pulp an amount of oil which is a fraction of one per cent, might not—although it could be by the doctrine of equivalents—might not possibly be construed as applying to a condition of things wherein the defendants did put into the ore pulp an amount of material which might be called an oil, in a proportion that was slightly greater than a fraction of one per cent, and they might obtain the results which for the first time were obtained by the process of the patent in suit; and it seemed to us that we would be in a better position in maintaining our rights to the invention which the Supreme Court gave us, if we validated those claims, by limiting their scope so as not to have the mathematical foot rule definition, but that definition which the Supreme Court expressed, "the results obtained by the use of oil amounting to a fraction of one per cent on the ore," and that is why we did it that way.

I may say that we also felt convinced that had we

filed a disclaimer on these claims in toto, the defendant would come to this court and say—"Why, those plaintiffs, by their affirmative act, have disclaimed any process wherein there is put into the ore pulp any quantity of oil exceeding a fraction of one per cent; they have done it affirmatively and they can not by any possibility—ask for the application of the doctrine of equivalents—the remaining claims must be limited to the measurements expressed in them"—those are the considerations that led us to take this step; so that we come to this court with claims 9, 10 and 11 validated by the disclaimer of that part of their scope wherein the Supreme Court said they were broader than that to which they should be confined.

Now, if your honor please, this proceeding—this trial—is upon the pleadings, and for the purpose of this trial and for the purpose of the interlocutory decree, which is the only decree which can follow this trial should the decree be for the plaintiff—we have only to prove, and we shall submit to the court as the only consideration that is pertinent, that after the issuance of this patent, during the existence of this patent and before the commencement of this suit, the defendant performed an act of infringement. Having proved that the defendant in that period performed an act of infringement, we have established our right to the interlocutory decree, which directs the injunction and which directs the accounting, which within your honor's discretion may be referred to a master in whole or in part, a matter that will be considered when we get to that part of the trial.

Now, for the purpose of the issues here involved, or the interlocutory decree which we ask at this trial, we have a [illegible]

P. 2211, L. 4, insert after " claims ", " *res adjudicata*, and will try to prove it, the plaintiff claims "

[illegible] have not had time to get together this morning, but it is understood—and we also have depositions that were taken.

The Court: The stipulation covering the infringement?

Mr. Williams: Covering the acts of which we complain.

Mr. Kremer: As to the amount of oil.

The Court: I see.

Mr. Williams: In addition thereto we took some testimony, which was by depositions, nearly three years ago, based upon examination and assay of a specimen of the concentrates of the Butte & Superior Mining Company, which were obtained from a car at Oklahoma, and the stipulation will identify those concentrates as concentrates obtained by the defendant at its flotation plant; the evidence already taken by deposition will be filed, and from our view point—there is of course the question of law as to whether or not those acts of the defendant are acts of infringement, and as to that, of course, the Hyde decision will control; that seems to the plaintiff as the whole case that is before the court, up to the point of the interlocutory decree.

Now, that completes my opening, and I presume it is unnecessary to note that the record in the Hyde case

is offered in evidence, but if it be necessary it is noted here that the entire record in the Hyde suit is offered in evidence.

Mr. Kremer: The record in this court?

Mr. Williams: Yes; that being of record in this court. Then the mandate, the decree and mandate of the Supreme Court of the United States in the Hyde case are also offered in evidence. It so happens that those documents are in Helena this morning, but the defendant is fully advised as to them. The mandate itself and a copy of the decree of the Supreme Court annexed to the mandate, happen to be in Helena this morning. They are offered in evidence, however.

Mr. Kremer: We have no objection; they may be offered at this time.

Mr. Williams: The disclaimer of March 28, 1917, is offered in evidence by a certified copy thereof.

Mr. Kremer: To which also we object for the reason that the purported disclaimer is no disclaimer in point of law, for the reason that the disclaimer, in its very language, discloses the fact that the complainant disclaims nothing; that there is no relinquishment of any purported right to claims 9, 10 and 11 embodied in said disclaimer; that the only attempted relinquishment of said claims is covered by the statement as follows: "Excepting where the results obtained are the results obtained by the use of oil in a quantity amounting to a fraction of one per cent on the ore," by such exception the plaintiff nullifying all previous attempts at disclaimer, making the disclaimer mean nothing and not yielding to the decision of the Supreme Court of the United States that said claims were invalid in toto.

For the further reason that the said disclaimer was not filed until the 28th day of March, 1917, and the decision of the Supreme Court in the Hyde case, holding claims 9, 10 and 11 of the patent invalid, was rendered on the 11th day of December, 1916, and, under the statement of counsel here made in court, the date just mentioned is correct; and the mandate upon which he seeks to avoid unreasonable delay was issued on the 13th day of January, 1917, 74 days before the filing of the disclaimer.

For the further reason that, taking the notice and not the process of the court, which was chargeable to the complainant, therefore the date would be as of December 11th, 1917, and, by reason of the foregoing the complainant has been guilty of an unreasonable neglect and delay in the filing of the said disclaimer within the meaning of Sections 4917 and 4922 of the Revised Statutes of the United States.

For the additional reason that it is the law of the land, the decision of the Supreme Court of the United States, that said disclaimer must be filed immediately upon the rendition of the decision by the highest court in the land, that being the highest court in the land.

Now, if your honor pleases, we are prepared to argue this case, if your honor desires to hear argument upon it at this time. Shall we proceed?

The Court: Yes.

Mr. Kremer: At the outset, if your honor pleases, without indulging to a protracted degree into the his-

tory of patent law, it would be well to observe that the statutes protect the right of the patentee.

I suppose you take the position that the patent in suit was offered in the Hyde case, and it is therefore in this case.

Mr. Williams: Yes.

Mr. Kremer: That is the position I take.

As I started to observe, the statutes perfecting the rights of the patentee are very few, and the law with reference to his rights and the limitations upon his rights is exceedingly simple, as is ofttimes observed in a discussion of the historical facts surrounding the law of patents.

The right to a patent had its origin in the giving of grants to favored courtiers, to the bestowal of exclusive rights to certain favorite courtiers, and in that manner the question of monopoly first received attention, followed by ultimate resentment from the people who were oppressed by the king's prerogative of granting to one man that which no other man should enjoy. That was the origin of patents. The holder of the monopoly at that time occupied no other position than the holder of a patent today, shorn of the restrictions which the law places about monopolies and patent rights. This condition became so distasteful that it resulted in the enactment by parliament of the Act of Monopolies, which I believe was in 1623. This was followed by judicial interpretation. One exception alone was made to the Act of Monopolies and that was where one had invented or had from his own brain

conceived that which was a benefit to the nation, he, to a limited extent, should enjoy the fruits of his own ingenuity. And it was upon that that the patent law of today was based. In this country the rights of patentees rest almost exclusively upon the power granted by the Constitution to Congress and the enactments of Congress.

Now, it is hardly necessary for me to observe that judicial interpretation instead of being of a liberal scope, as has been indicated by counsel in his opening statement, has been zealous of these public rights. It has restricted the rights of the patentee, and only recently, within the week, the Supreme Court of the United States has thrown additional restrictions about the so-called rights of patentees and has announced the rule that, "Thus far shalt thou go, and no farther," because you enjoy that under the guise of law to which you would have no natural or just rights if it were not for the operation of the law. Now, with this in mind, let us approach directly the question before the court.

If it were not for the enactment of Section 4917 and Section 4922 of the Revised Statutes of the United States, the patent in suit, or any patent, any part of the claims of which had been held invalid, would be void, and of no force or effect. I take it there can be no dispute and will be no dispute between counsel in this case as to that being the rule of law. The reason for that is based upon that which counsel perfectly expressed in the pleadings of this case, insofar as it applies to the common law defense. And this portion

of the answer rests on a paragraph, the rule of the common law as to the validity of the patent contained in paragraph 3 upon page 18 of the original answer: "This defendant avers that for the purpose of deceiving the public the description and specifications filed by the said patentees in the Patent Office was in some particulars made to contain more than the whole truth relative to their alleged invention or discovery and more than is necessary to produce the desired effects, and that in other particulars the said description and specification was made to contain less than the whole truth relative to their alleged invention and discovery." And, upon that state of facts, at common law, a patent was held to be invalid in toto. If there was one invalid claim the patent failed by reason of the defect in structure. Why? It was a safeguard to the rights of the public, because if that were not true—and I am attempting at this particular time to address my remarks somewhat to the inquiry propounded by your honor to counsel when we were discussing the entering of the decree in the Hyde case—because if that were not true and there were 18 claims in a patent and 17 of them were invalid and only one valid, the claimant could then go on and hold himself out to the public under the guise of having a patent issued in his name, under the guise of a claim of right, and thereby deceive the public and prevent the public from the ultimate enjoyment of something that might be of great public weal. It is to safeguard the public that this rule of law exists. Therefore the same rule exists with reference to the statement of 18 claims where

there is one invalid claim as exists as to the statement of 18 claims where there are 17 invalid claims. There is no distinction.

Now, I take for granted that counsel will admit, and if they do not, then the question can be speedily and readily disproved by the slightest examination of the authorities, that in the absence of these two remedial statutes this patent in suit would be entirely void. I use the words "remedial statute" because counsel has declared to the court in his very able explanation of the patent law, that these are remedial statutes and thoroughly remedial statutes.

Now that brings us to this question: First, is it necessary for the complainant in this case to comply with these sections of the Revised Statutes of the United States in order to save its patent from entire invalidity? Second, is the disclaimer here on file in law a disclaimer?

I shall take up the first question and at the outset I desire to call the court's attention, although it does not appear as the first case cited in the brief which I hold in my hand, the case which I believe can well be considered the leading case upon this subject, the case of O'Reilly vs. Morse, 15 How. 62, 14 Law Ed. 609. And before discussing that question I desire to refer to the statement made by counsel in his opening argument that some of the courts have held that six months is not too long, six months is not an unreasonable delay under certain conditions. I challenge counsel to show that such a condition ever existed whereby the court gave it that consideration where there had been a de-

cision by the Supreme Court of the United States. Your honor will find upon an examination of the authorities that the courts have held that four weeks, two weeks, ten days or 45 days—I think that is the maximum I have seen—is not an unreasonable delay because the invalidity of the patent or the invalidity of the claim of the patent had not been adjudged by the highest court in the land. The converse of that reasoning then must be that if the highest court in the land had decreed the invalidity of the claim of this patent then that length of time would have been an unreasonable delay. There can be no answer to that logic. Therefore we are then confronted with this situation: that if the highest court in the land has decreed the patent invalid then this is the final word, and it is incumbent upon a claimant to no longer deceive the public by holding himself out to the world as the owner of a claim that the Supreme Court has said he does not possess. Therefore, I take it, and I believe, that he must move expeditiously, because with that decision his rights terminated and any act of his subsequent to that time is an infringement upon the rights of the public and a direct violation of the law of the decision, in view of the fact that he is encroaching upon the limitations of the monopoly.

Now, referring to the case of O'Reilly vs. Morse. the court said in part: "The law which requires and permits him to disclaim is not penal, but remedial." The law which *permits* him to disclaim is remedial. "It is intended for the protection of the patentee, as well as the public, and ought not therefore to receive a

construction that would restrict its operations within narrower limits than its words fairly import. It provides, 'when any patentee shall have in his specification claimed to be the first and original inventor and discoverer of any material, or substantial part of the thing patented, of which he was not the first and original inventor, and shall have no legal or just claim to the same,' he must disclaim in order to protect so much of the claim as is legally patented.' " I think, if your honor please, that that paragraph answers very completely the inquiry that you propounded to opposing counsel this morning. " 'Whether, therefore, the patent is illegal in part because he claims more than he has sufficiently described, or more than he invented, he must in either case disclaim, in order to save the portion to which he is entitled, and he is allowed to do so when the error was committed by mistake.'

" 'A different construction would be unjust to the public, as well as to the patentee, and defeat the manifest object of the law, and produce the very evil against which it intended to guard.

" 'It appears that no disclaimer has yet been entered, at the patent office; but the delay in entering it is not unreasonable, or the objectionable claim was sanctioned by the head of the office, it has been held to be valid by a circuit court, and difference of opinion in relation are found to exist among the justices of this court. *Under such circumstances the patentee had a right to insist upon it, and not disclaim it until the highest court to which it could be carried had*

pronounced its judgment.'" And that has been done in this case; has been long since.

"'The omission to disclaim, therefore, does not render the patent altogether void, and he is entitled to proceed in this suit for an infringement of that part of his invention which is legally claimed and described. But, as no disclaimer was entered in the patent office before this suit was instituted, he cannot, under the Act of Congress, be allowed costs against the wrongdoers, although the infringement should be proved.'"

Therefore that decision in the O'Reilly case holds that when the highest court of the land had pronounced invalid the claim of a patent the disclaimer must be filed without unreasonable delay; and that unreasonable delay certainly falls within a limitation no less than the time in the suit at bar.

Again, your honor, referring to the question of claims in the case of Seymour v. McCormick, 60 U. S. page 96, 15 Law Ed. 557, the Supreme Court in discussing the rule said "It is said by the learned counsel of the defendant, that there is a claim in the patent outside of the two claims that are in controversy, which is void, because McCormick appears, from the evidence, not to have been the original and first inventor and that inasmuch as he had made one void claim his patent is void, as it respects all the other claims. Although the evidence may show that he was the original and first inventor of all these other claims, as regards the law applicable to this point, the learned counsel is not strictly correct. The law is this:

if a patentee makes a claim which is not well founded in the same patent with other claims which are well founded, he may disclaim, within a reasonable time that which he had no right to claim, and then his patent will be good as to the residue—as good as if it had originally issued only for claims which are valid. If he omits to make a disclaimer, but brings a suit for the violation of his patent, and it satisfactorily appears upon the trial that he is entitled to be protected in a portion of the claim set up in his patent, but that he is not entitled to be protected in respect to another portion, he is still entitled to damages for a violation of the valid portion of his claim, the same as if all the claims were valid, so far as regards the mere right of recovery, but he gets no cost. That is the law. It has this qualification: if the jury are satisfied that there has been unreasonable negligence and delay on the part of the patentee, in making a disclaimer as respect the invalid part of his patent, then the whole patent is inoperative, and the verdict must be for the defendant, as in this case the claim on which the question arises is as follows: . . . . "
And it goes on. That was a case for damages, tried before a jury and this was said in discussing an instruction given to the jury, but of necessity that same principle applies in actions at law as maintains in a suit in equity. The O'Reilly Morse case is cited to the same effect, and Silsby v. Foote, 61 U. S. 377-378.

I will say to the court in passing that I have found no rule contrary to these decisions to which I have just referred; I have endeavored to select what I con-

sider the best considered and so-called leading cases upon this subject, trying to use the Supreme Court of the United States decisions in all instances, and I believe I have done so in all save one, the case to which I will refer in closing. In the case of Silsby v. Foote, and I desire to call your honor's attention to the strong dissenting opinion of Mr. Justice Grier, in which dissenting opinion Justice Grier discussed this question of disclaimer.

It has been suggested by Mr. Sheridan that ~~both~~ the majority decision as well as the dissenting opinion agree upon the facts in the case, and that there exists only a difference of opinion in connection with the limitation that should be placed upon the time of filing of the disclaimer. I direct your honor's attention to that case. It is not at all opposed to any case here cited, but, on the contrary, very strongly upholds the uniformity of the decision of the Supreme Court of the United States on this question.

Smith v. Nichols, 88 U. S. 112, 22 Law Ed. 566 is another case dealing substantially with the same question.

In a very recent case the court in speaking of the matter of disclaimer, spoke as follows:—this was a case in which one of the distinguished gentlemen appearing upon the other side appeared—Motion Pictures Patents Co. vs. Laemlle and others, 214 Fed. 796. I think Mr. Kenyon was of counsel in that case. The court in the discussion of this question of disclaimer says, "It was quite natural that the valuable additional rights thus conferred by the disclaimer act

sections should be surrounded with substantial safeguards, and the Congress determined that the patentee should not eat his cake and have it too." A very homely way of expressing it, but at the same time a very forcible way. "Therefore, it was provided among other things, that no patentee should be 'entitled to the benefits of this section' if he 'unreasonably neglected or delayed' to enter a disclaimer. 'The benefit of this section' undoubtedly mean the right to 'maintain a suit at law or in equity for the infringement of any part thereof.' (Meaning 'the thing patented') 'which was bona fide his own.'

"There has been a good deal of discussion as to what would constitute unreasonable neglect or delay so as to deprive a patentee of the benefits of the disclaimer section, and, when appeals in patent cases went direct to the Supreme Court, it was held that the delay until the Supreme Court had finally passed on the validity of the claim was not unreasonable. O'Reilly v. Morse. 15 How. 62, 120; Seymour v. McCormick; Gage v. Herring" cited by the court.

"It is urged by counsel for complainant that since the creation of the Circuit Courts of Appeals by the so-called Evarts Act, a delay to disclaim cannot be held unreasonable until the patentee has first exhausted every effort to reach the Supreme Court of the United States. Such efforts have not infrequently involved the litigating of the validity of a patent, in even more than two Circuits, as was instanced in the Grant Tire Case, which was held invalid by the court of Appeals for the Sixth Circuit, 116 Fed. 363, and

again by the court of Appeals for the Seventh Circuit, and later came before the Court of Appeals for the Second Circuit, which held the patent valid. (Consolidated Rubber Tire Company vs. Firestone Tire & Rubber Company, 151 Fed. 237, 80 C. C. A. 589), and finally reached the Supreme Court by certiorari, where the decision sustaining the patent was affirmed (Diamond Rubber Company v. Consol. Tire Company, 220 U. S. 428"—) citing a number of cases. As I said, this case is reported in 214 Fed. That is ~~the~~ perhaps the latest decision of any court on this very important question of disclaimer, and in this opinion the district judge, I believe, has embraced the better considered decisions, showing the uniformity of law in connection with this matter of disclaimer.

So, if your honor pleases, without prolonging this discussion by the citation of additional authorities, which would no more than bear out the statement of the law as embraced particularly in the O'Reilly-Morse decision, as well as the Silsby-Foote decision and the Seymour-McCormick case, I believe that we can rest upon the statements that we made in the beginning, it being borne out by the decisions that in order to save their patent from complete annihilation, so to speak, it is incumbent upon them to disclaim these claims that the Supreme Court held to be invalid and that by failing to disclaim they have imposed upon the public to the extent of holding themselves out as the owners of a monopoly upon a process embraced within these claims 9, 10, and 11, when they in fact do not own it.

Now, that brings me to the disclaimer itself. As

has been called to your honor's attention, they say, "We disclaim 9, 10, and 11, but we want to keep this much of it." If these claims are invalid, as the Supreme Court has said they are invalid in toto, there is no part of it that you can separate. What they do attempt to do in this disclaimer, if your honor please, is to ask this court to reissue this patent, and by so doing they ask this court to do that which it is powerless to do. Now, they say we disclaim 9, 10, and 11 except where the results obtained are the results obtained by the use of oil in quantity amounting to a fraction of one per cent on the ore. I tried to understand the excuse presented to the court this morning for this character of disclaimer, but I could not. I am perfectly willing, however, to attribute that to my own lack of intelligence rather than to the clearness of explanation by Mr. Williams. But, be that as it may, the request here is a request for a reissuance of this patent; and from the date of the decision of the Supreme Court of the United States on December 11, 1916, to this very hour, there is no disclaimer within the law in the patent office or in this court or anywhere else. This is not a disclaimer. To use the homely language that I referred to but the expressive language, of the distinguished judge who decided the Motion Picture case, they are endeavoring to eat their cake and have it too.

And, as has thus been suggested, there is no foundation in the body of any specification for any claim as that here attempted to be made in that disclaimer. So, if your honor pleases, it takes but a perusal of this

paper, so-called disclaimer for your honor to determine that they are now saying, "We waive it, but we wish to hold a part of it." Now, by taking that paper by the four corners and examining it briefly, they must purge themselves of their deception in the manner which the law imposes by a renunciation of these invalid claims; they must come in and say in the very language of the court that declared them invalid, "we relinquish all rights to claims 9, 10, and 11, in order that we may enjoy the fruits of that which this court has decreed to be good," and until they do that, they have no place in a court of law, much less in a court of equity. Even if it were not for the rule of law which so clearly demands a compliance with these provisions, in equity and good conscience, they could not be heard to come into a court of equity asking equitable relief unless they approach the Chancellor with clean hands, which the maximum of equity demands. But here is a statute which limits their right, it gives them an opportunity to save something if they do a certain thing. It carries with that the forfeiture of all that they might claim if they refuse to do it. In the case of National v. Stecher, 81 Fed. 395, the following was held; where the limitation or requirement of the disclaimer pertains to an invention which would require an amended specification, a disclaimer is not the proper method. It means a reissue, and that is exactly what they have asked here and they cannot obtain that relief here. So we submit this question to the court with full confidence that we have come well within the rule of law in this objection, and we believe that the

decisions of the Supreme Court of the United States upon this all important question, without the shadow of a doubt, upheld the position here taken by us and that in view of that condition and in view of the fact that up to this hour they have not filed a disclaimer but tenaciously cling to that which the Supreme Court has said they were not entitled to, we maintain that in the light of these combined conditions we are entitled at this time to have this objection sustained and this patent declared invalid by reason of the fact they have shown by their actions that they do not believe that their rights are amenable to the plain provisions of the law.

MR. KENYON: I did not anticipate that this disclaimer question would be argued at this time and haven't all my authorities at hand, but can present them in a memorandum without much delay, and can present now an outline of what they show.

I was not concerned in the Motion Pictures case against Laemelle to which Mr. Kremer referred but I was engaged in prior litigation between the same parties where a disclaimer question arose. The particular question to which Mr. Kremer refers—the particular case to which Mr. Kremer refers was brought after a reissue had been taken of the Edison Motion Picture Camera patent. Prior to the taking of this reissue, litigation through two or three years, of a very strenuous character, proceeded upon the unreissued patent up—it had previously been reissued for another purpose—and there the defense was unreasonable, neglect and delay in filing a disclaimer, and

the delay there had been four years and a half after the Circuit Court of Appeals in New York had a second time held a certain claim 4 invalid and too broad and certain other claims valid and not too broad. The plaintiff, after that decision, in 1907, had gone forward and enforced the decision of the Circuit Court of Appeals as to the validity of claims 1, 2 and 3, taking advantage of it created a monopoly of the motion picture business under claims 1, 2 and 3 of that patent, and doing nothing as to the claim 4 that had been decreed invalid by that Circuit Court of Appeals once in 1902 and again in 1907. And I will say that on both occasions, in 1902 and in 1907, petition for a writ of certiorari had been made to the Supreme Court from the decision of the Circuit Court of Appeals and had been denied. So that that decision, as to claim 4 being invalid in that litigation, stood as the last holding of the highest court to which the case could go. And in Motion Pictures Company against Yankee Company, (187 Fed. 1007) we stood upon that defense of unreasonable neglect or delay as a defense to a motion for a preliminary injunction upon claims 1, 2 and 3 which had been held valid, the invalid claim 4 was not there in suit. The Circuit Court of Appeals denied the motion for injunction because there was so much doubt on the question whether the delay of four and a half years had been too long. The plaintiff argued in that case that it was not too long and the court was in doubt whether four and a half years was too long, but it denied the motion for the preliminary injunction, expressing its doubt, whereupon the plain-

tiff reissued, striking out that claim 4, substituting for it a corresponding claim 4 limited as claim 1, 2 and 3 had been, and adding another claim 5 as to some other details, and it was then subsequently so reissued with that same restricted claim four as well as claims 1, 2 3 and 5. The judge held that the reissue was good, whatever the doubt about there having been previously an unreasonable neglect or delay in filing a disclaimer. But no one in that whole litigation from beginning to end pretended that a delay of a few months would have constituted unreasonable delay or that anything other than this long interval of four or four and a half years during which time the plaintiff was enforcing by countless suits and motions for preliminary injunction the claims 1, 2 and 3,—that part of the decision of the court that had been favorable,—and had treated with contempt, the part of the decision of the court that had been unfavorable.

Now, on this general question of unreasonable neglect or delay, I have, I think, studied every case that has ever turned upon that question or discussed it from any point of view, and I have yet to know a single instance of a patent having been declared invalid because of unreasonable neglect or delay in filing disclaimer.

In Mason v. Bushnell, 96 Fed. 238, where the delay was from May when the court spoke—it was there a Circuit Court of Appeals—to July when the disclaimer was filed, although the argument was made that that was too great a delay the court brushed it aside with impatience. "There is no force—" said Judge La-

combe, speaking for the Circuit Court of Appeals in the Second District—"in the contention that there has been any unreasonable delay in filing the disclaimer. Defendant insists that the owners of the patent should have realized the necessity of so doing when the evidence as to prior use of a narrow tempered slip in circular saws and back saws was introduced in the Jennings case. (November 28th, 1902). But the Circuit Court in that case, with such evidence before it, did not consider disclaimer necessary. It was only when the decision of this court was filed, May 28th, 1915, that the owners of the patent were apprised of the necessity of disclaimer, and they filed it in July, 1915. They certainly acted with reasonable promptness."

I will call to your attention other illustrations of delay of that sort, from a month, three months, six months—I haven't them here at the minute—where the courts have brushed aside the suggestion that the delay was unreasonable. Courts, under such circumstances, take the reasonable view that in matters of such importance as a disclaimer, counsel and the parties are entitled to do the thing deliberately, to do the thing with care, with thoughtfulness, with consultation, with re-consultation before the act is done. Because what is a disclaimer? It is a surrender for all time, irrevocable by the party interested, beyond the power of any court in the land to recall to him, irrevocable beyond any power of the land except that of Congress to reinstate him with what he has by that act dedicated to the public. It is the most solemn sort

of a dedication of something to the public which he can never recall, which he can never thereafter contend in any litigation belongs to him. It has gone into the public domain by that solemn act of his of filing at Washington a disclaimer notifying all the public that they are free to use the thing disclaimed, so far as he is concerned, and so far as that patent is concerned. A reasonable man, when the property is of value and importance, a reasonable man would take time to consult one counsel, and to consult another counsel and to consult associates across the water, if there those associates lived. They have the right to take reasonable time before taking such a step as that. Now, we do not know whether the defendant in the Hyde case is going to petiton to the Supreme Court for rehearing of that case or not. The defendant in the Hyde case has the right to file with the Supreme Court at Washington a petition for rehearing of that whole case.

THE COURT: How long?

MR. KENYON: Up to next October.

THE COURT: You have the same right?

MR. KENYON: We have the same right; until we disclaimed this overplus of claims 9, 10 and 11, we had the same right until next October to file a petition in the Supreme Court to review and rehear that part of their decision and mandate which refers to claims 9, 10 and 11. I say that time cannot possibly, in the strictest legal interpretation or in equity, that time cannot have begun to run against us until the expiration of that right of ours, which would be the last day of September of 1917. Now, what harm has come,

because of our delay of 74 days of pondering; what harm has been occasioned, to anybody? Mr. Kremer suggested that we have by not disclaiming been continuing to assert claims 9, 10 and 11. I take issue with him there. We have not asserted these claims against anyone; we have not filed a bill of complaint against anybody alleging infringement of these invalid claims since the Supreme Court pronounced them invalid. We have not taken a step in any litigation where that position has been asserted. We have not asserted that in literature; we have not asserted that against the trade. We have taken, deliberately and carefully, time enough to consider what the Supreme Court decision means because that was the first great question we had to decide. What did it mean? What were our rights and privileges under the law, in view of that decision? It was then our duty to consider the form that our disclaimer should take and to consult with all of those whose property it was. And, above all, we had to decide whether to go back to the Supreme Court with a petition for a rehearing and ask them to change that part of their holding. That was an important matter and a difficult matter for us to decide; and the opinion of the Supreme Court is expressed in such a way that we have had real difficulty in understanding what it really meant and what duties and obligations it really placed upon us. Has the defendant, by reason of this delay, during this period of 74 days, done anything it would not have done if we had earlier filed a disclaimer? There is no evidence or suggestion of anything of the kind. The suggestion

that we have unreasonably neglected or delayed to file this document should be brushed aside as unworthy of consideration. It has not a consideration of substance supporting it; of equity supporting it, of common sense supporting it.

Men, in the great affairs of life, do not act overnight. They cannot act within a week. They may well delay a month. They may well delay three months. That time came out of the term of our patent. It cost us something but it cost the defendant nothing. In no way has it harmed the defendant.

Now, on the question of the proper nature and character of this disclaimer. It is the sort of disclaimer that is within the exact purpose and function of the law and the rule of law in its remedial enactment, that where a patent covers more than it ought to cover and that more can be eliminated by simply cutting off, then the patentee, by filing a solemn document at Washington called disclaimer, cutting all overplus off, may make his patent good ~~and keep~~ for the residue for what is left, enabling him to sue for infringement one who infringes what is left, and not abating any suits previously begun, but affecting them only in the matter of costs, the disclaimer inuring to the benefit of the suit, in the middle, at the end, at the beginning, anywhere in the pending litigation, and benefitting the plaintiff in future litigation just to the extent that it validates his patent for what is really his invention, disclaiming only an overplus or what is not his invention. The statute says nothing about claims. The disclaimer statutes say nothing about claims. It only

knows what the patent covers and includes and it is as applicable to a patent with only one claim as it is to a patent with one hundred claims in it.

WHEREUPON an adjournment was taken until 2:00 o'clock P. M., Monday, April 16th, 1917.

2 o'clock P. M.

MR. KENYON: (Continuing) If your honor please I have now my fuller notes with me on the cases on this subject. I will first quote from the case Carnegie Steel Co. vs. Cambria Co., 46 L. Ed. 968, at 985; 1901, Justice Brown.

"Upon the hearing defendant seems to have insisted that certain portions of the specifications were broader than the second claim. Those parts of the specifications therefore were disclaimed. As we had occasion to observe in Sessions vs. Romadka, 145 U. S. 29, 36 L. Ed. 609, 12 Sup. Ct. Rep., 799, 'the power to disclaim is a beneficial one, and ought not to be denied except where it is resorted to for a fraudulent and deceptive purpose.' In that case the plaintiff was permitted to enter a disclaimer of all the claims but one in suit, the patentee having included in the patent more devices than properly could be the subject of a single patent. In the case under consideration the disclaimer was not of a claim, but of certain statements in the specification, which if retained might be construed to have the effect of illegally broadening the second claim. The first statement disclaimed was that the invention

might be practiced by *merely* receiving a number of small portions of metal taken from different ladles, the mixing being performed *merely* by the act of pouring into the charging ladle. The use of the word 'merely' ignored the steps embodied in the second claim, where the mixing is not performed by merely pouring together the several charges into a ladle, but by maintaining a permanent quantity of metal in the reservoir, into which charges were alternately added and from which they were withdrawn. The other clauses were intended to disclaim the casting of the metal into pigs. We think there is no force in the criticism that a disclaimer may not extend to a part of the specification, as well as to a distinct claim. Hurlbut v. Schillinger, 130 U. S., 456, 32 L. Ed. 1011, 9th Sup. Ct. Rep. 584; Schillinger v. Gunther, 17 Blatchf., Fed. Cas. No. 12458; Schwartzwalder v. New York Filter Co., 13 C. C. A. 380, 26 U. S. App. 547, 66 Fed. 152. Had the purpose of the disclaimer been to reform or alter the description of the invention, or convert the claim from one thing into something else, it might have been objectionable, as patents can only be amended for mistakes of this kind by a re-issue. But the disclaimer in this case appears to have been made to obviate an ambiguity in the specification, and with no idea of obtaining the benefits of a re-issue. If the clauses had the effect of broadening the patent the disclaimer removes the objection. If they did not, the disclaimer could do no harm, and can not be made the subject of criticism."

I will also refer to Tuck v. Bramhill, 3d Fish. Pat.

cases, 400, Fed. Cas. 14213, and Taylor v. Archer, 4 Fish. Pat. Cas. 449, Fed. Cas. 13778.

I note that in Carnegie v. Cambria Iron Wks., there was this situation, that the claim might have a broad or a narrow scope. The broad scope was too broad, the narrower scope covered the real invention. This language in the specification left it in doubt whether the claim covered the broad field or the narrower field. The patentee filed a disclaimer, thereby himself asserting and admitting the narrow scope by disclaiming anything over and above the actual invention. I have the form of that disclaimer here. After the formal part it says: "Enter this disclaimer to those parts of the specification which are in the following words, which your petitioner desires to erase from the specification," then it enumerates—"or the metal is cast into pigs or otherwise used." That is all of the disclaimer, and it did not change a word in the claim, but it took out of the specification matters that might have compelled the court, in construing the claim, to hold it and construe it as of a broader field than the real invention, and therefore wholly invalid.

Now, in Tuck v. Bramhill, 6 Blatchf., 95, after the testimony on both sides had been put in before the examiner, the plaintiff filed a disclaimer setting forth that he was the owner of the patent, and making his disclaimer, "to that part of the claim which covers the packing therein described without a core," thereby causing the claim to include only the packing formed out of saturated canvas, so cut as that the thread or warp shall run in a diagonal direction from the

line or center of the roll of packing, and rolled into form in connection with and around an India rubber core, or one of other elastic material, meaning the said claim to include only the combination of an elastic core, with saturated canvas, having threads running in a diagonal direction, as described in said patent, wound around the same." The court says: "It having been shown that the forming of the roll in the manner described, without the core, was old, the next question is whether the plaintiff could disclaim, as he ... to do the forming of the roll without the

P. 2237, L. 12, insert after " core ", " and limit to the forming of the roll with the core "

claims more than that of which ... original or first inventor; but the disclaimer can not be made unless some material and substantial part of the thing patented is truly and justly the invention of the patentee, and, in such case, he is authorized to make disclaimer of such parts of the thing patented as he does not claim to hold by virtue of the patent. The defendant contends, that the claim of this patent is not equivalent to two claims, and that, therefore, under the statute, the patentee has no right to disclaim anything in the claim. But this objection has been already disposed of. The forming of the roll within the core is one material and substantial part of the thing patented. The forming of the roll with the core is another material and substantial part of the thing patented.

"The patentee was not the first inventor of the for-

mer; he was the first inventor of the latter. The two are clearly separable and distinguishable. The claim is too broad, and claims more than that of which the patentee was the first inventor. A clear case, therefore, existed, under the 7th Section of the Act of March 3d, 1837, for a disclaimer by the patentee of so much of his claim as covered the forming of the roll without the core. The disclaimer goes exactly to that extent. It disclaims that part of the claim 'which covered the packing therein described without a core;' and then it goes on to state what the claim will be after such disclaimer, namely, that it will 'include only the packing formed out of saturated canvas, so cut that the thread or warp will run in a diagonal direction from the line or center of the roll or packing, and rolled into form in connection with and around an India rubber core, or one composed of other elastic material', and that it will 'include only the combination of an elastic core with saturated canvas having threads running in a diagonal direction as described in the said patent, wound around the same.' This disclaimer is unambiguous, and leaves the claim as if it had originally claimed only such combination. It is substantially just such a disclaimer as the Supreme Court in Silsby v. Foote, 14 Howard, 218, 221, held to be valid. The claim there was to 'the application of the expansive and contracting power of a metallic rod, by different degrees of heat, to open and close a damper, which governs the admission of air into a stove, or other structure, in which it may be used, by which a more perfect control over the heat is obtained than can be

by a damper in the flue.' It having been shown that the application of the expansive and contracting power of a metallic rod, by different degrees of heat, to regulate the heat of other structures than a stove in which the rod was acted upon directly by the heat of the stove, or the fire which it contained, was not new with the patentee, he entered a disclaimer 'to so much of said claim as extends the application of the expansive and contracting power of a metallic rod by different degrees of heat, to ~~say~~ any other use or purpose than that of regulating the heat of a stove in which such rod shall be acted upon directly by the heat of the stove, or the fire which it contains.' The Supreme Court sustained such disclaimer as a good disclaimer under the 7th section of the Act of 1837."

The original claim is found in Patent Office reports of 1855, page 573, and was as follows:

"The forming of packing for pistons or stuffing boxes of steam engines, and for like purposes, out of saturated canvas, so cut that the thread or warp shall run in a diagonal direction from the line or center of the roll and packing, and rolled into form either in connection with the India rubber core or other elastic material, or without, as said core."

So the disclaimer practically strikes out the words "or without", from the claim leaving it thereby covering a narrower field. Now, to contrast the remedy of disclaimer with that of reissue, the statute is that wherever, similarly without fraud and by inadvertence.

accident or mistake, an error has been made in taking out the original patent,—both statutes, reissuing and disclaimer statute are founded upon that,—and a change in, or additional specification or claim is necessary,—then reissue must be resorted to, and with its heavy penalty; first that in a reissue you must surrender your original patent, and with the surrender of that original patent abates every suit for infringement that has been begun on it, abates every claim of profit and damages because of infringement—that is all wiped off the slate by the act of surrendering the original patent as a condition for getting a reissue of patent. And in addition, in the Patent Office, the Patent Office examiners have a responsibility with respect to a reissue correction, and they have none with respect to a disclaimer. Their responsibility with respect to the reissue correction is that they re-examine the entire field of validity and novelty, and consider over again every claim made and the responsibility for doing that is upon the Commissioner and his examiners, and the proceeding is long and expensive and may involve interferences, just as the original application for patent. So the reissue statute, while it is remedial and beneficial,—it was passed in 1832, and it was passed to mitigate the severity of the situation about which Mr. Kremer spoke, that where there is a single claim too broad in the patent, the whole patent and every claim in it is invalid; that was common law; the English law at that time. To mitigate that, came this reissue statute, and five years later,—1836 or 1837, to meet the case where a mere cutting off of part

of the claims was required, came the disclaimer statute with its greater benefit, namely that it involved no surrender of anything in the past, no surrender of the old patent or of claims of infringement; no re-examination in the Patent Office; no proceeding by the Commissioner of Patents in which he had a function and no responsibility or duty upon him; it was simply a formal—the most formal possible sort of a gift to the public, a dedication of something that could be distinguished or that was left and could be dedicated to the public by simply cutting it off from the claim.

Now, another example. Electric Accumulator Co. v. Julien Electric Co., 38 Fed. 117.

(Coxe C. C. 2, 1889.) There is in that case a very long and interesting discussion of the whole subject of disclaimers by Judge Coxe away back in 1889, that your Honor will find interesting and useful. On page 137 Judge Coxe discusses the facts in the case before him. There was only one claim there and it covered the application of an active coating to a supporting core, for the purpose of a secondary or storage battery; the application in the form of a paint, paste or cement, or by galvanic deposition or chemical precipitation or otherwise. That was the claim, the electrode made in that way.

Says Judge Coxe: "The part of the invention which bona fide belongs to Faure is an electrode in a secondary battery consisting of a support coated with an insoluble layer of active material in the form of a paste, paint or cement, so as to be or instantly become spongy, etc. It was this that the scientific world rec-

ognized as a discovery of great merit and importance. It was this that the distinguished Scotch electrician (Lord Kelvin) regarded as 'marvelous.' And this was the result of Faure's genius. No one anticipated him. It is honestly his. But what he did not invent was an electrode in a secondary battery, coated with a soluble layer of active material. Neither did he invent an electrode on which the active material is applied by 'galvanic action or chemical precipitation, or otherwise.' The claim is broad enough to cover all these forms probably, and some of them certainly. What he is not fairly entitled to he wishes to give up, and keep what is certainly his own. He does not seek to broaden his patent, but greatly to restrict it. No one will infringe unless he constructs his battery in the one way to which the patent will be confined. This is the patentee's way, and it has many distinguishing characteristics which differentiate it from the ways pointed out by others. The matter to be relinquished is distinct and separate, and can be exscinded without mutilating what is left. No amendment is necessary. The claim, read in the light of the description, is too broad. It is sought to limit it. The disclaimer suggested will not make a new patent, or a different invention. The invention is fully described in the specification, and the limited claim will stand on that description. After giving the subject a most careful consideration it is thought that Faure was the originator of the invention just described and that it would be unjust to him to declare the patent wholly void, if he is willing to restrict it to what is lawfully his own."

The disclaimer is found in 47 O. G., 276, April 16, 1889.

"The Electrical Accumulator Co., New York., N. Y., enters its disclaimer to—

'From the first claim of said letters patent, No. 252002, any electrode of a secondary battery coated with an active layer of absorbtive substance, to which this active layer is wholly applied otherwise than in the form of a paste, paint, or cement, practically insoluble in the electrolytic liquid.'"

So there is the identical sort of emasculating exception, as Mr. Kremer called it, that occurs in our case, the exception being the residue that was left, the invention that was really made, attained by the exscinding of everything else. In addition the disclaimer cut out these phrases from the specification. "In the form of a deposit by galvanic action or chemical precipitation or otherwise," also in another sentence the words "in any suitable way," also in another place the following "the plates *a* can be coated with an active porous layer in any suitable way." Those phrases are struck out.

Now, another illustration, Thompson v. Bushnell, 96 Federal 238. This was a simple little mechanical case. The patent after the disclaimer was held to be valid; it had been held invalid before the disclaimer. The disclaimer was filed and the patent held valid, and the court discusses the question of the disclaimer.

"It was intimated that the patent could be sustained only if limited to hack saws and band saws. Acting

upon this suggestion, the owners of the patent on July 18th, 1895, filed a disclaimer in the Patent Office 'of so much of said claims as covers circular saws and hack saws, leaving said claims to include only hack saws and band saws.'"

"Thereafter they brought this suit, and upon proof that defendant had sold some saw blades that in the opinion of the court were 'either hardened to the base line of the teeth, or so near it that the variance from the distinctive fractional tempering of the patent was trivial,' the Circuit Court entered an interlocutory decree for injunction and accounting, from which decree this appeal is taken.

'The appellant contends that the disclaimer is not a proper one, and is therefore void. The theory of this contention is that there is no separate invention, and that, inasmuch as the different kinds of metal saws known to the art are distinguished from each other by their particular kind of mounting, a restriction of the claim to any one kind of saw is practically adding to the claim a new element, to wit, the kind of mounting. Reference is made to Machine Company v. Searle, 8 C. C. A., 476, 60th Fed. 82, and to Hailes v. Stove Co., 123 U. S. 582, 8 Sup. Ct. 262, where it is held that disclaimer cannot be availed of when 'it requires an amended specification or supplemental description to make an altered claim intelligible or relevant.' But this cause is not within such ruling. The invention, and the sole invention, of the patent, as was held in the Jennings case, consisted in locating the temper line practically coincident with the bottoms of the teeth. It

is manifest that this location of the temper line might be applied to any one of the four well known varieties of saw—circular, back, hack, or band; but, if applied to circular or back saws, it would subserve no useful purpose, and the patent might fairly be held void for want of utility. When applied to hack or band saws, however, it would accomplish 'a desirable result', as the Circuit Court and this court both held. The phraseology of the claim, however, read in connection with the specification, was broad enough to cover all four varieties of the class known as 'metal saws', although as to two of them it was useful, and as to the other two useless. Certainly there was an actual, separable invention, and a specification and claim broader than the invention. In view of the fact that the four varieties of this class of saw were well known to the trade and their difference clearly recognized, as the evidence shows, no amended specification or supplemental description is required to make the new claim intelligible, and a disclaimer of circular and back saws leaves the patent in force as to the other varieties of the class.

"There is no force in the contention that there has been any unreasonable delay in filing the disclaimer. Defendant insists that the owners of the patent should have realized the necessity of so doing when the evidence as to prior use of a narrow tempered slip in circular saw and back saws was introduced in the Jennings case (November 28th, 1892). But the Circuit Court in that case, with such evidence before it, did not consider disclaimer necessary. It was only when the decision of this court was filed, May 28th, 1895, that

the owners of the patent were apprised of the necessity of disclaimer, and they filed it in July, 1895. They certainly acted with reasonable promptness.

Now, another illustration. Schwarzwalder v. New York Filter Company, (66 Fed. 152), Second Circuit Court of Appeals, 1895. In that case a part of the specification was disclaimed. The court says: "The claim is as follows:"—Here again, there was only one claim—"The method of arresting and removing the impurities from water during an interrupted passage of same from a supply pipe into a filtering apparatus, then through a filter bed contained therein—" I will read the latter part: "Which method consist in introducing into the water, simultaneously with its passage through or into the filter, a substance which will sufficiently coagulate or separate the impurities to facilitate their arrest and removal by the filter bed, thus obviating the necessity of employing settling basins." It was narrowed down with respect to these substances, so note the language: "A substance which will sufficiently coagulate or separate the impurities to facilitate their arrest and removal by the filter beds, thus obviating the necessity of employing settling basins."

Now, continues Judge Wallace: "After a litigation upon the patent in a suit in the United States Circuit Court for the Northern District of Illinois, in which, in February, 1889, the bill of infringement was dismissed, and on July 27th, 1889, the owner of the patent filed in the patent office a disclaimer of that part of the specification of the patent which is in the following words: 'I do not confine myself to the em-

ployment of persulphate or perchloride of iron or permanganate of potassia, but make use of any other suitable agent which is capable of coagulating impurities of the liquid and preventing their passage through the filter bed. Neither do I limit myself to any particular proportion of quantities of the coagulating agents, as they may be varied according to circumstances and the character of the liquid to be treated. Nor do I confine myself to any particular liquid although I contemplate chiefly the purification of water in large quantities.' "

Now, all of that broadening language and specification was stricken out by the disclaimer after the unfavorable decision in Illinois.

"But it has been urged for the appellants, that the patent before the disclaimer covered broadly any continuous process of filtration of any liquid in which the treatment with any coagulants or reagents is adopted and that the validity of the patent as regards the defense of want of novelty is to be tested by its original terms and scope. We are aware of no principle which permits a patent to be defeated for want of novelty in respect to the subject-matter which has been eliminated from it by a disclaimer. The office of a disclaimer is to enable the patentee to save himself from the peril of such a defense. Matters which have been properly disclaimed cease to be a part of the invention, and, as was said by the Supreme Court in Dunbar v. Myers, 94 U. S. 104; 'It follows that the construction of the patent must be the same as it would be if such matters had never been included in the description of the invention or the claims of the specification.' "

Judge Wallace, continuing says: "It is also urged for the appellants that the effect of the disclaimer was to limit the method of the patent to one in which perchloride or persulphate of iron is used as a coagulant. If these coagulants, only, instead of coagulants 'Such as perchloride or persulphate of iron', had been mentioned in the description of the invention, there would be much force in the argument; and it might well be held that by disclaiming 'the use of any other suitable agent which is capable of coagulating the impurities,' all equivalents would be excluded. The literal effect of the disclaimer is to confine the claim to a method in which no other coagulants are employed except 'such as salts of iron.' It is to be observed, however, that the part disclaimed is not part of the descriptive matter, but a recital intended to enlarge the scope of the claim. The disclaimer consequently operates only to expunge from the claim what otherwise would, by force of the recital, be incorporated into it constructively. Obviously, it was intended to obliterate the recital from the patent, and to have no other effect. The patent, after the disclaimers, is to be read exactly as though the recital had never been inserted. Thus read, it is clear that the claim covers the use of any coagulant having similar properties to the salts of iron, which was a recognized equivalent."

Another illustration. Simplex Company vs. Pressed Steel Car Co., 189 Fed. 70, Second Circuit Court of Appeals. There the patent after disclaimer was held valid and infringed. Judge Coxe, speaking for that court says: "The specification contains a statement

that, though the best results are obtained by keeping the tension member straight, if the construction be varied by bending the tension member and keeping the compression member straight it will still be within the spirit of the invention.

"The Circuit Court, however, permitted a disclaimer to that part of the specification, so that the patent is now limited to a bolster having a straight tension member and a compression member with its end bent at a point approximately over the place of support. That the court was entirely justified in permitting a disclaimer is, we think, clearly established by the authorities. The effect of the disclaimer was not to broaden the claim, but to limit it to the construction described and shown, of a straight tension member and a bent compression member. Until this disclaimer was allowed it was possible to contend for a construction of claim 6 broad enough to include a structure described in the language disclaimed, viz., a straight compression member and a bent tension member. That this was a proper case for a disclaimer and that the language disclaimed is no longer a part of the specification, are propositions which are sustained by the following authorities: Dunbar v. Meyers, 94 U. S. 187, 24 L. Ed. 34, and cases cited in Accumulator Co. v. Julien Co. (C. C.) 38 Fed 117, 133-136.

"In Carnegie Co. v. Cambria Co., 185 U. S. 403, at page 436, 22 Sup. Ct. 698, at page 711, 46 L. Ed. 968, the court says:

'Had the purpose of the disclaimer been to reform or alter the description of the invention, or convert the

claim from one thing into something else, it might have been objectionable, as patents can only be amended for mistak~~ing~~es of this kind by a reissue. But the disclaimer in this case appears to have been made to obviate an ambiguity in the specification.' "

Now, says, Judge Coxe, "The sole effect of the present disclaimer is to limit the sixth claim to a structure embodying Bauer's actual invention and strictly within its terms. The statement eliminated by the disclaimer was unnecessary and was not advisedly inserted, but there is nothing of which to predicate a fraudulent intent. The statement is gone and to that extent the atmosphere is cleared."

And still another, Libbey v. Mt. Washington Glass Co., (26 Fed. 757), Judge Colt, 1886: "The claims of the patent are as broad as the specification, and are not limited to any particular compound. Since bringing suit, the plaintiff has filed a disclaimer under the statute, in which he limits his claim to the gold-ruby compound. This the plaintiff had a right to do. Under the authorities cited by the plaintiff, this was a patent where a part could be properly disclaimed. It did not require the importation of anything new in the specification, but simply the elimination of a part of what was originally claimed. A disclaimer can be made after suit is commenced.

"The argument of defendants that they have to meet a different case since the disclaimer, and that, therefore, a supplemental bill should be first filed, and then another motion for a preliminary injunction, does not

seem to have much force in this case. The defendants have long been apprised of the real nature of this controversy, and that Locke's claim was confined to variegated glassware made from gold-ruby. This was the main issue in the interference proceedings in the patent office between Locke and the defendant Shirley, where the examiners in chief, in a well considered opinion, decided in favor of Locke as the prior inventor. The disclaimer has been filed since August 29th, and the defendants, so far as appears, have had sufficient time since then to prepare their defense to this motion. We do not see how their rights have been prejudiced in any degree by the disclaimer."

One other example—there are an endless number of them in the books—Page v. Dow, 200 Fed. 72, ~~1892~~ 1912, Hazel Judge.

There the patent had been declared valid and the claim infringed. "The record before the court is the result of a supplemental bill averring infringement of claim 12, which heretofore was held not infringed, and which was amended by disclaimer filed in the patent office after affirmance by the Circuit Court of Appeals of the original opinion. It was held by me on rehearing that the 'constantly acting source of power', an element of the original claim 12 did not mean the constantly rotating shaft with which the machine is provided, but referred solely to the electric motor which drives the shaft as the said source of power.

"Claim 12, as amended by the disclaimer, reads substantially as follows:

"'12. In a printing telegraph receiver, the combination of a type-wheel, paper-feeding mechanism, a constantly rotating drive shaft, and means for continuously feeding the paper without feeding the type-wheel as long as said drive shaft is supplying power, for substantially the purposes set forth.'

"It will be noticed on comparison with the original claim that the words 'a constantly rotating drive shaft' have been substituted in place of the words 'constantly acting source of power' . . . .

"The defendant insists that the disclaimer changes the character of the invention and substitutes a different element, but I am persuaded by the proofs to the contrary. To substitute the words 'constantly rotating drive shaft' for the words 'constantly acting source of power' did not, in my opinion, alter or change the invention; nor was it the addition of an equivalent element for one that had been abandoned. The effect of the disclaimer was merely to limit the original claim, which was thought too broad, to a constantly rotating drive shaft actuated by a constantly rotating motor. Disclaimers of this description, when filed within reasonable time of the discovery that a disclaimer is necessary, have many times received the approval of the Federal Courts." A long citation of cases.

Then, there is a most excellent discussion of this whole law of disclaimer in Suddard v. American Motor Car Company, 163 Federal, 852, which I will not go into here, simply an interesting case to study and a

long essay on the subject, a very able treatment of the whole question.

Now, our disclaimer here, what is it? It is simply a cutting off and exscinding from claim 9, 10, and 11 of that excess, whatever it may be—we don't know—of that excess which caused the Supreme Court to say and to hold these claims invalid and too broad.

And down to what did we cut these claims? We cut these claims down to the exact invention which the Supreme Court says we made and to which the Supreme Court says our patent must be confined. We quote the language of the Supreme Court in our disclaimer. This is the language of our disclaimer following what the Supreme Court says, "Does hereby disclaim from claims 9, 10 and 11 of said letters patent"—the universal, the general, the accepted method of disclaimer—"We do hereby disclaim from these claims any process of concentrating, the process of concentrating powdered ores,"—these words are quoted from these three claims—"process of concentrating powdered ores," here is the way each one of these three claims start. "Excepting—" we disclaim everything "excepting—", now we are not going to disclaim what the Supreme Court has said is ours, not one mite of what the Supreme Court has said is ours, not one jot or tittle of what the Supreme Court has said is ours are we going to disclaim, are we going to abandon, are we going to dedicate to the public; but everything else, everything except that, we dedicate to the public. Any process—we disclaim from these claims any process of concentrating powdered ores excepting—now, we put in the Supreme

Court's definition—"where the results obtained are"—now we don't use quotation marks, but they might have been used—"the results obtained by the use of oil" in a quantity "amounting to a fraction of one per cent on the ore." Now, whatever—that is it is based on this language of the decision of the Supreme Court, "and the patent must be confined to the results obtained." The "patent must be confined to the results obtained." Now, the Supreme Court identifies these results this way: "By the use of oil within the proportion often described in the testimony and in the claims of the patent as a proportion amounting to a fraction of one per cent on the ore." So we disclaim everything from these claims, everything that would be within the language of these claims 9, 10 and 11, excepting. where the results obtained are (as the Supreme Court says we are entitled to claim), the results obtained by the use of oil in a quantity amounting to a fraction of one per cent on the ore.

It was our purpose and intention to disclaim from these claims and so from the patent everything that the Supreme Court held or thought was not ours. It was our purpose and intention to retain within the patent and within these claims of the patent everything that the Supreme Court has held is properly ours, and in the language of the Supreme Court where it defines what is properly ours—that language we may not know what it means, that language is to be construed perhaps by this court, perhaps by the Supreme Court itself, perhaps by other courts, but whatever it means as used by the Supreme Court, that

it means as used by us in our disclaimer. If by "results" the Supreme Court meant the rising of this froth, and the concentrating in that way, that we propose to hold and claim by these claims 9, 10 and 11 of our patent. If the Supreme Court meant to contrast a result which we could not hold, the Cattermole effect of granulation and securing the concentrating of the ore in that way, we disclaim that by our disclaimer. Our disclaimer leaves as a residue in the patent, in our intention, nothing but that subject matter which the Supreme Court has said is justly ours. Our disclaimer leaves in the patent in and by claims 9, 10 and 11, in the legal effect, nothing but what the Supreme Court has held is justly ours, and it is a proper case ~~question~~ for disclaimer and is not a case for re-issue, because to attain that end nothing has to be added to the complaint, not a word to the specifications of the claims, no different description need be given anywhere, nothing has to be done but to deduct the overplus, whatever that overplus may be, dedicate that to the public, and that we do by our disclaimer; and nothing more do we do by our disclaimer.

Now, if your honor pleases, the other claims in the patent may fill the whole measure of that invention, and they may not. That is a question that may arise in future litigation, possibly in this. If they were not broader than the real invention the Supreme Court would hold them valid as it did even though they were narrower.

A man may claim less than he has a right to claim as new. So the Supreme Court would hold valid any

claim that was less narrow in its scope than the real invention.

For example, it has validated some claims that are limited to heat. Our invention is not limited to heat; it is broader than that. Claim No. 3—that was inside the road scope of the invention. Claim No. 2 is limited to the use of an acidified pulp. The Supreme Court has held No. 3 and No. 2 valid. No. 2 is narrower than our entire invention. Some of the other claims validated are limited to very microscopic quantities of oil. An example is claim No. 5, limited to from .02 up to .5; clearly that is narrower than the purview of our invention as defined by the Supreme Court, because it has said that the patent must be confined to the results obtained by the use of any fraction of one per cent. Claim No. 5 is a claim of one half of one per cent, or under. So the validating of those claims does not mean that the Supreme Court was of the opinion that they filled the whole bill, that they went to the utmost extent of our invention. When we come to claim one and twelve, they may fill the full measure of our invention or they may not; they are limited to the process wherein the oil referred to and that operates in the process is a fraction of one per cent—anything up to one per cent. That may be the full measure of our invention in the intention of the Supreme Court, and it may not. The Supreme Court, in contrast to that, said—"the patent must be confined to *the results* obtained when that amount of oil is used." Now, if somebody, within the language of claims 9, 10 and 11, obtains that result, although he may obtain it by using

more than one per cent of oil, he is within that definition of what we are entitled to claim, which the Supreme Court has laid down for us and for you and for the defendant here, and we think that that definition is the law of this patent, and in filing this disclaimer as to claims 9, 10 and 11 and disclaiming those claims down to the exact and whole subject matter of what the Supreme Court has said is fully and justly ours, we have done what we were privileged to do under the law; we have taken out what the disclaimer stated and by cutting off what was not justly our own, but in doing that we are not required to cut off one jot or tittle of what is our own, irrespective of whether the other claims are up to the full measure of that property or not. So we filed a document, a disclaimer, within the letter and spirit of the disclaimer statute, within the authorities of a half century, within common sense and reason, cutting off what was not ours and retaining what is ours, and adopting in that disclaimer for the definition of what is ours, the definition that the Supreme Court itself had given.

Now, to hold that a few weeks' delay in filing this disclaimer is fatal to the whole patent would be a farcical catastrophe, and absolutely without precedent in the administration of patent law and particularly of that statute since the year 1837 down to the present year, 80 years afterwards, and as to the form and substance of the disclaimer, it deals with substance and not with the form; it goes to the core of the matter. The Supreme Court has told us what we did not ourselves know before, or when we took out this patent,

just what the boundaries of our invention are, and by this document we cut those three claims down exactly to that boundary, thereby insuring to ourselves that we have some claim or claims in this patent up to the full measure of that boundary, so that not a bit of the territory that belongs to us but what is claimed here.

MR. KREMER: May it please your honor, I feel after having heard the argument of Mr. Kenyon that there was some reason why I should not have understood the statements of Mr. Williams in connection with the filing of the disclaimer; after having heard the argument just concluded I feel now that I should no longer speak from a standpoint of misgiving, but confidently assert that no disclaimer has been filed either within the meaning of the statute or within the intent of the decision of the Supreme Court. Instead of having eliminated anything from the scope of the patent or the claim of the patent, I assert that this disclaimer in its very language gives that claim the full breadth that it had before any attempted disclaimer was filed. Before discussing that, I want to say that I am sorry if I, in my argument, conveyed to counsel that I believed there was anything mystical in the use of the term "claim"; whether it is a single claim or one of a great number of claims, or whether there is only one claim in the patent makes no difference. It is the invention that the patentee must claim. In the case at bar it was the invention that Minerals Separation claimed. The invention of what? The invention of a process or of a result? I was astounded to hear these distinguished patent lawyers in their arguments to this

court allege that the Supreme Court had ever said that they could patent a result, or to hear them assert that a result is patentable, because it is an elementary doctrine of patent law that a result is not patentable. So, disregarding this statement that a result is patentable, we return to the process, and the process in this case is the only thing that is patentable. And what is that process? The Supreme Court—and as lawyers practicing before that court we are forced to accept the decision of the Supreme Court in the language in which it is given, and to comply with the law in connection therewith until that court itself modifies it or changes it—the Supreme Court held that the patent in this case was the patent of a process, not a result, wherein there was a quantity of oil of less than one per cent used. Now, they hold that claims 9, 10 and 11 are invalid. Why? Because they did not fall within the specification of less than one per cent, as it defines in this opinion the critical amount, and I say to your honor that by no forced construction can the effect of this decision be avoided by this plaintiff; by the artful use of words, segregating a single line from the utterances of that court and reading it, so to speak, into a disclaimer, any more than if this court should say, "No, you can't do this, though if you do a certain thing then you will be permitted to do it." I could not argue on that that this court had said "No, you can't do it." They take a single line and by artful use of that line change the effect of the decision. They put a statement in the disclaimer which would render it absolutely meaningless. Can they be heard to contend,

in the light of this decision, that the Supreme Court held that their invention embraced the use of an amount of oil, say, equal to three per cent upon the ore? 3.6 for instance, the Cattermole proportion, as I recall? That is a small amount of oil. It was that very feature, as it appears from the record of the Hyde case on file in this court and which is now before your honor—that was represented as a small amount of oil. It appeared that there was a resultant froth. It is true that counsel drew, as the records show, a metaphysical distinction upon the ground that there was more oil in the froth. Be that as it may, the Supreme Court in reviewing that record declared that their patent ceased at an amount within one per cent, and that claims Nos. 9, 10 and 11 were invalid. Why? Because there was a use of more than a fraction of one per cent. The merest tyro in reading that decision could place no other construction upon it, and yet in this disclaimer which is here now on file, and the only disclaimer that we have, it disclaims—note the artful manner in which it is put—it disclaims claims 9, 10 and 11, except as to the result obtained by the use of oil in a quantity amounting to a fraction of one per cent upon the ore.

In this verified record, which is before the court, it conclusively appears, and your honor saw the demonstration in this court room, that the result is the resultant froth; that is the result of the application of these processes; the result is the same, the resultant froth, and the Supreme Court has limited their patent to the use of less than one per cent of oil—they disclaim 9, 10 and 11, but at the same time assert that it extends

to three per cent or four per cent or any other per cent, which any court, any place might at any time hold to be a small amount of oil. Therefore I say that they have disclaimed nothing; they have eliminated nothing, as was done in the Silsby-Foote case; they have not eliminated as was done in the McCormick case or the Hull case, or any of the cases cited by the distinguished counsel for the plaintiff. It is a claim without a limitation; they have eliminated nothing. And in this court here and now, after that decision, they are asserting the right to claim all that they have ever claimed before the decision of the Supreme Court of the United States—hence, your honor, the delay. Hence the delay. It was the desire to artfully seem to yield, without yielding, and even though conquered in that respect, they are still unyielding. They are as unreconstructed today as the man who fired the first shot in answer to the one at Fort Sumpter; they have yielded nothing in principle and they yield nothing in law. And so they have come to this court, and in language eloquent and appealing, in the lack of analysis—they say to this court—'Dare this court apply this rigorous rule of law and destroy what is ours or what would have been ours if we had only filed this disclaimer? Will we be forced to yield this valuable patent because we have not filed a disclaimer?' They have sought to avoid the provision of that law, and they must pay the penalty.

There was a statement made of which I took note at the time, in reference to their right to apply to the Supreme Court of the United States for a rehearing.

That rule is simply the equity rule, and it permits any party to make application for a rehearing during the term in which the decision is rendered. There are two ways—we must not take these rules to be formed wrongly, because the rules are supposed to have been born and were born of intelligent thought directed to the conduct of litigation. They could have filed a petition for a rehearing, or they could have ordered this mandate down, and when they ordered this mandate down—and it is of record here whether physically present or not—it is filed; Mr. Williams offered it and it was accepted to be filed when it arrives—that is before the court, and when they have ordered that mandate down and have filed no petition, and when the rule of law required them to act in a manner that was expeditious and not to delay in doing what the decision of the Supreme Court required them to do—and they ordered that mandate down, then they stand in law as having surrendered their right to petition for a rehearing. So this is not an excuse for a delay in the filing of a disclaimer, and they have not filed a disclaimer within the meaning of the law.

It would be but a mere matter of repetition to discuss the law of this case, because I find no reason to differ with the principles of law read by Mr. Kenyon from his long and able brief. He has not cited a case that is in opposition to any that we have cited. The simple distinction exists between all of those cases in which he referred to the lapse of time, and the cases to which I referred this morning—the simple distinction exists that mine were utterances of the Supreme

Court of the United States, and he never cited one single Supreme Court decision to your honor upon the question of the right to file a disclaimer after a decision by that court. That is the simple distinction between those cases. The only other distinction between the cases that I cited and those which Mr. Kenyon cited are that Mr. Kenyon sought to construe certain cases as eliminating or yielding certain features of certain claims of patent, while in the cases I cited the yielding was an entire giving up of those rights claimed. I do not assert that they could not yield those claims in part, but where they yield them in part, they irrevocably and irretrievably surrender a part of what they did own; not what Mr. Kenyon referred to as a dedication; they only returned to the public what did belong to the public, and never was the property of the patentee.

So that is the distinction of the law of those cases, and we submit this matter to your honor, and do it, feeling that our position is even stronger in the light of the language of the disclaimer filed here in than it would have been if it had not been filed at all, because the reason is taken from their own disclaimer, that reason being, as I have just stated, that they were reluctant to surrender anything under this decision. We submit that this disclaimer has not been filed without unreasonable neglect and delay, and we submit further that, by their so-called disclaimer they have yielded nothing, therefore the disclaimer should be considered as not having been filed at all.

(Recess.)

THE COURT: Well, gentlemen, I need not say to

counsel, of course, that while the court is presumed to know all law, there is some patent law with which it is not familiar. As a matter of fact this is the second seriously contested patent case that has been tried in this court in five years, my present incumbency; and of course there is a great body of patent law with which I am not familiar. When you were stating what was to be proven in this case, why it certainly seemed to me it was not within the language of that statute, and turning back to the 15th Howard, it seems to me, that they had found it to be within the statute largely from construction—more than from the necessities of the case.

Even within the Morse-O'Reilly case they hold that Morse had tried to cover all future inventions of machinery which by means of the electric telegraph might print at a distance, which seems to me to be a different thing than what is involved in this case. The statute says, claiming something that had theretofore been discovered, and that is not what would seem to me to be this case. However, the plaintiff himself seems to think that it is, and of course the court is not inclined to quarrel with their attitude in that matter, and undoubtedly since the O'Reilly case a large body of law by decisions has firmly established the principle of this.

This patent in the Hyde suit seems to have been held invalid as to claims 9, 10 and 11, and the court in so declaring declared that the patent must be confined to the results obtained by the use of oil within the proportion often described in the testimony and in the

patent—which we have called the critical proportions, a fraction of one per cent of oil to the ore. Claims 9, 10 and 11 in the patent run higher than the critical proportion of oil, a fraction of one per cent, and do not define the quantity in that way, but speak of it as using a small quantity of oil.

Now, the court having held those invalid, and apparently they being within the disclaimer statute, the plaintiff has filed a certified copy of his disclaimer, wherein he says:

"Does hereby disclaim from claims 9, 10 and 11 * * * any process of concentrating powdered ores, excepting where the results obtained are the results obtained by the use of oil in a quantity amounting to a fraction of one per cent on the ore."

The court does not understand how the use of any other process is to be dealt with than that set out in this patent, and that part of it defined in 9, 10 and 11 or any other results other than that arrived at by the use of the process of the patent—oil, and in some acid, heat in others, and agitation in others, for the purpose of securing the froth. If, as the cases seem to hold, a claim which is in part ambiguous, as I say this is, that comes within the disclaimer statute, the court is of the opinion that the disclaimer in this part would be sufficient, for this reason he has to disclaim the excess over and above what he has invented; he has to make his patent to that extent specific and definite and free from ambiguity. These claims, 9, 10 and 11, as they now stand, have embodied within them and include within

them a portion of the process which is called the use of a fraction of one per cent of the oil with the ore. That is included within it—I see no reason why he cannot exclude or except that to which he has a right and that which is included. The language as it now stands in 9, 10 and 11 will permit him to use a fraction of one per cent of oil in the operation of his process, and it might be construed—and this I take it is its vice—according to the decision of the Supreme Court as permitting a percentage of oil above one per cent. Excluding, as he does, all except a fraction of one per cent of oil, he retains simply that to which he is entitled by the specifications and the other claims of patent; they are specifically set out therein. I know of nothing in the cases read which would require him to give up this portion of the claim, for it is a part of the claim. The law does not seem to require that, that an entire claim shall be abandoned, but only an excess of that which is held to be valid, in accordance with the other terms and specifications and claims of the patent.

In referring to the time of the filing, the statute fixed no time, other than to say that it shall not affect any pending suit only insofar as the question of unreasonable neglect and delay are concerned. The court would be very loath to hold, regardless of the right to apply for a rehearing in the Supreme Court, that some 100 days after the decision, or a little more—perhaps 110—and something like 75 after the mandate came down—that such a delay in a case of this kind, a patent of this nature, would involve unreasonable neglect and delay. Of course I take it in patent law—I think I can

venture that far—that the law is not thinking solely and only of the possibility of damage to the litigating party, the defendant here—but also of the rights of the public, in constructively insisting that there shall be no unreasonable delay or neglect in making a disclaimer. The court can not see that there has been any unreasonable neglect or delay here, and the court will so hold.

The court will say further at this time that of course both parties are here prepared to try this case, and the court intends that you shall try it, and be permitted to try it, on the merits. Many of the court's rulings may be more or less tentative. If there is shown reason in the final argument to change its ruling on the law, the court will do so. Of course it will not take anyone by surprise nor operate as an injury to either party, not having had the ruling made exactly at the time that it is called for. So the court will not hesitate to change its views of the law.

The objections to the admission of this disclaimer are overruled.

The defendant asked and was allowed an exception.

MR. WILLIAMS: I don't know that I made it quite clear that in offering the record in the Hyde case in evidence I included the decrees that have been entered therein since the time when that record was first offered in evidence in this suit, including the final decree which was entered today. I include them and offer them in evidence.

Now, there are certain depositions which were taken in 1914 and which have been on file in this court for some three years or so. Those are the depositions of Hugh N. Line, Ernest O. Jacobson, and Charles Frederick Chandler. Those depositions are now offered in evidence.

In connection with the taking of those depositions, certain articles were marked for identification. They are described in the depositions. I regret that I have not those articles here physically present, but they were the seal of the car, the number of the car, a bag and a bottle of concentrates, and they will be in my physical possession about Wednesday morning, and I merely wish now to offer them in evidence as described in the depositions, and will actually produce them later if there is no objection.

MR. KREMER: They are all the articles that were marked for identification?

MR. WILLIAMS: Yes, as described in the deposition.

MR. KREMER: I don't recall whether the record shows any objection to the introduction of these articles or not; if so, you may introduce them now and we will reserve the right to renew the objections to the court when they are produced, provided there were any objections made at the time.

THE COURT: Were they introduced in evidence?

MR. WILLIAMS: They were marked for identification, but not introduced.

THE COURT: You may renew the objections when they are produced.

MR. KREMER: Yes, if there were any objections noted at the time.

MR. WILLIAMS: Counsel for the defendant and myself have agreed to make a stipulation as to the infringement. Mr. Scott pleads that he has not had time to state the exact terms of that stipulation, and I can not now put it in evidence, but we have agreed upon a stipulation which will describe sufficiently the operations of the defendant, to make it unnecessary for us to produce any further proof on the subject of the acts, which we charge to be infringements. We have one other subject as part of our prima facie case, which will receive the attention of Judge Garrison.

MR. GARRISON: If your honor please, we have served on counsel for the defendant a notice and a supplementary notice, to produce, and before proceeding with our oral testimony I desire to have the response of counsel for the defendant to the various items in the notice to produce and in the supplemental notice. The first item is, "any and all agreements, contracts, written undertakings, or written memoranda between James M. Hyde and the Butte & Superior Mining Company, by whatever name said company was known, or any one who was acting or purporting to act for it from January 1st, 1911, to date, or if they have not the originals of any such, then copies of the same. What is the response to that question?

MR. KREMER: The notice was served upon me personally this morning, if your honor please. I deliv-

ered the copy that was served upon me to Mr. Bruce, and a search is now being made to see what, if anything, we have. Are you going to proceed down with your list of items?

MR. GARRISON: Yes, my intention was to proceed down with my list of items and get your response to each, unless you can make a comprehensive response, and save time.

MR. KREMER: I might do that. Insofar as the documents and matters referred to are concerned, the same statement applies, that we are making a search for them.

THE COURT: It was served on you this morning?

MR. GARRISON: That is perfectly reasonable.

MR. KREMER: I think that the general response will suffice. As to the portion of the subpoena duces tecum that is directed to me personally, I would say as to that—

MR. GARRISON: I have not spoken about the subpoena duces tecum; I am speaking about the notice to produce.

MR. KREMER: Well, it is the same thing.

MR. GARRISON: I ask you to respond to the notice to produce.

MR. KREMER: That is what I am doing. The part that applies to correspondence by counsel, I may as well state to you now as at any other time, that, as far as the correspondence of counsel is concerned, under the rule of privilege and not being relieved by my client, it naturally follows that I would decline to produce any correspondence of a professional character with reference to my client's case.

MR. GARRISON: Do I understand that as far as the notice to produce is concerned, your response to that part of it which refers to correspondence between Hyde and the officials of the company is that you have not yet had time to make such search as will enable you to make a proper response?

MR. KREMER: Exactly.

MR. GARRISON: As far as that goes, we cannot go on until they have made search and responded, because we cannot produce oral evidence as to these documents until they have failed to produce the originals.

With respect to the item concerning the correspondence to which Mr. Kremer referred, the request as to that is in the supplemental notice, and reads as follows: "All letters and copies of letters from the officers, employes, managers, superintendents, counsel or attorneys for the company to the attorneys or counsel for James M. Hyde, in Minerals Separation, Limited, against Hyde, or to Kremer, Sanders & Kremer, attorneys or solicitors for Hyde, or to J. Bruce Kremer or to Thomas F. Sheridan or Walter A. Scott, or to Sheridan, Wilkinson, Richmond & Scott, or to Sheridan, Wilkinson & Scott, counsel for Hyde, respecting or referring in any way or in any part therein to the conduct or management or control or direction, or continuance or discontinuance, or the method or means of continuance of the defense of said Hyde therein, and all letters and copies of all letters from said attorneys for Hyde or from said counsel for Hyde, or any of them, to the company or to any of its officers, attor-

neys, counsel or employes, respecting or relating in any way or in any part to the conduct or management or control or direction or continuance or discontinuance or the methods or means of continuance of the defense of said Hyde in said case."

Now, we are not asking for any confidential communications between Hyde and his counsel; we are asking for communications between the Butte & Superior Mining Company and counsel for Hyde. Now unless Mr. Kremer is making a response in confession and avoidance, I cannot understand the nature and propriety of his response. He says, "You have called upon us to produce correspondence between the Butte & Superior Mining Co., which was not my client in the Hyde suit, and Hyde or counsel for Hyde, and I refused to respond to that because of the doctrine of privilege." The doctrine of privilege can only be urged where a relation of counsel and client exists. Now, if Mr. Kremer will admit now upon the record that he and Mr. Scott and these other gentlemen represented the Butte & Superior Mining Company in the Hyde case, then of course it will be a matter protected by the doctrine of privilege under the familiar application of that doctrine; but if they were representing Hyde and not representing the Butte & Superior Mining Company in that suit, then correspondence between the Butte & Superior Mining Company and them as counsel for Hyde certainly is not protected by the doctrine of privilege—by any doctrine of privilege that I have ever heard of in any court in the land. I therefore insist that I am entitled to it.

MR. KREMER: I think that I can answer that quite generally. I thought you were directing your remarks to the Hyde matter. We represented James M. Hyde in that case, but I am quite sure that I can respond now by saying that there is no correspondence between ourselves as to the conduct of that case, directed to the Butte & Superior Copper Co. Limited. If there is, why we will search for it and examine it, and if we think it is proper matter under your subpoena, we will submit it to the court subject to any objection we may have.

MR. GARRISON: That removes the misunderstanding, We are not calling, of course—

MR. KREMER: I promise subject to that—

MR. GARRISON: You admit there can not be any privilege under this question?

MR. KREMER: As far as Mr. Hyde is concerned, I will state that, while I don't think there is anything important, yet, if it was only as to the color of someone's hair and it transpired during that employment, I don't think that I should testify to it or divulge it except by the permission of Mr. Hyde; but I do not deem it of any great importance except to myself as a practitioner.

MR. SHERIDAN: As far as we are concerned, your honor, I refer to Mr. Scott and myself—we got this notice this morning, and we are 2,000 miles or 1,500 miles away from our office, and I don't see how they expected us to comply with it unless they want to delay the case long enough for us to go back to Chicago and search the files; no clerk can do it. They

could not tell the difference between matters proper under the subpoena and improper. I don't see why they could not have notified us two or three or four weeks ago. They knew long enough in advance what they would want.

MR. GARRISON: We were misled by the testimony given by Hyde as to the relationship existing between him and this company, until our good fortune opened our eyes as to the truth.

THE COURT: You are not asking the impossible?

MR. GARRISON: No, sir, certainly not.

THE COURT: You cannot ask the court to sit here and wait until these matters are supplied to you, very long?

MR. GARRISON: No, sir, we will not; if these gentlemen will respond with respect to what is here within their own knowledge, and that is ample, we will waive the rest.

THE COURT: They say they are making a search, and I suppose they will do so.

MR. GARRISON: Yes, sir.

MR. KREMER: Furthermore, in order that Judge Garrison may not further misunderstand, under the issues in this case it will be our position that any and all of the documents called for that are in that notice or in that subpoena duces tecum, are wholly incompetent, irrelevant and immaterial for any purpose, there being no issue in this case that would justify their introduction, if they did in fact exist, and for the further reason that by proceeding against this defendant in the manner in which they have, instead of proceeding in the

original Hyde case by supplemental proceedings, they are estopped and now disbarred from raising any such contention as that which they seemingly are attempting to raise here, by a privity ~~comity~~ between Hyde and the Butte & Superior, the allegations of the bill not being sufficient to justify such a proceeding. And further under the allegations of the bill the issues in this case, the Butte & Superior Company could not, taking the allegations of the bill with reference to Hyde and the Butte & Superior as true for the sake of the argument, they could not raise an issue that would prevent the Butte & Superior from having its day in court. The same question was raised and argued somewhat before this court, as I recall, upon one of the applications for an increase of bond. The statement was made there that this case was res adjudicata as to the Butte & Superior, and if I recall your honor's position—

THE COURT: I don't remember it that way. I think it was at the time the injunction was applied for.

MR. GARRISON: Yes, it was on an application for injunction.

MR. KREMER: Well, it was in one of those proceedings, I don't remember just which one.

MR. GARRISON: The court said there were not sufficient facts before him then to reach that conclusion.

MR. KREMER: But there was sufficient before the court upon the application for the increase of the bond; but that was several years ago.

THE COURT: Well, I suppose that your objection may be made when they offer their defense in that respect.

MR. GARRISON: That is the only other evidence that we have, stipulaion taking the place of the evidence as to the matter of the infringement, and then we are prepared to close.

THE COURT: The stipulation as to the alleged infringement, and about the matter being res adjudicata as it is.

MR. GARRISON: Yes, sir, with that exception we are prepared to close.

THE COURT: Is that pleaded?

MR. WILLIAMS: Yes, it is pleaded without question.

MR. KREMER: There is a question, and it is a question of law, too. There is no allegation seeking to show that it is res adjudicata in this. That will appear from the face of the bill itself. They allege in this bill that the Butte & Superior Copper Company, Limited, confederated with Hyde, but there is no basis there for showing that the Butte & Superior was a party to that suit. The bill speaks for itself.

MR. WILLIAMS: Read clause 8.

MR. KREMER: Yes, I will read clause 8. "On information and belief, that the defendant herein confederated with the said James M. Hyde in the acts of infringement complained of in the said suit against the said James M. Hyde and was an actual defendant therein, and conducted the defense of said James M. Hyde for his services in assisting in the defense of the said suit; that the acts decreed in the said suit to be acts of infringement were carried on under certain letters patent issued to said James M. Hyde on April 2,

1912, No. 1,022,085, and that since the commencement of said suit the said James M. Hyde assigned to the defendant herein all of the right, title and interest of the said James M. Hyde in, to and under his said letters patent No. 1,022,085, for, to and in the County of Silver Bow and State of Montana, that the acts decreed in the said suit to be acts of infringement were carried on in the mill of the defendant herein and by the employes of the defendant herein and have been continued by the defendant herein in the identical apparatus used by the said James M. Hyde; and that this defendant is a joint tort feasor with the said James M. Hyde in the acts thus decreed to be infringements and is in privity with the same James M. Hyde and is bound by the said decree against the said James M. Hyde."

That is all a matter of conclusion. This company could, from the standpoint of law, could have financed Mr. Hyde. That would not have made them a party to this suit. And their bare statement that it was a party defendant was insufficient in law. So, under the very allegations, this bill is framed upon an infringement, not by Hyde, but an infringement, as is testified to in this case, by Mr. Li~~m~~ne and Mr. Jacobs~~o~~en, and Dr. Chandler, and will be supplemented by the proof that you will offer.

And it is the act of infringement that has made the basis of this complaint.

MR. WILLIAMS: No, every action.

MR. KREMER: You cannot cover that by a general conclusion that somebody is a defendant in this case.

MR. WILLIAMS: What about conducting the defense of said suit?

MR. KREMER: Absolutely insufficient.

MR. WILLIAMS: And paying for the expenses thereof.

MR. KREMER: You have a perfect right to pay the expenses of any litigation you see fit.

MR. WILLIAMS: And conducting the defense?

MR. KREMER: The only thing you could possibly come in contact with would be an act of champerty in maintenance.

THE COURT: Of course the question would be whether he was your servant throughout and whether you were defending him as your servant and thus defending yourselves at the same time.

MR. KREMER: There is no allegation that Mr. Hyde was our servant.

MR. GARRISON: I don't understand your honor is going to pass upon this until it is raised in the proper manner.

MR. KREMER: Then we will ~~waive~~ raise it upon the demand here set forth and the statement of counsel that they are ready to proceed, ready to close their case about the presentation of this proof on those documents that they now demand. We then ask that the case proceed for the defendant for the reason that upon their own statement it is incompetent, irrelevant and immaterial and has no bearing upon the issues in this case and is not properly within the pleadings and the issues here raised. I think now it places it properly before the court.

THE COURT: Well, I will overrule your objection at this time, or your motion, whichever you make it, but when we come to offer this, if you want to be heard further, I will hear you.

MR. KREMER: Then we will renew the objection whenever the documents are presented.

THE COURT: Certainly. Then you are not prepared to proceed further today?

MR. WILLIAMS: Very sorry.

THE COURT: Will this stipulation be ready in the morning?

MR. SCOTT: I think, your honor, they will be ready in the morning. I want to verify the figures.

MR. GARRISON: Do I understand from the other side that insofar as your own records here are concerned, the records of the company and your own personal records you will be able to respond by tomorrow morning?

MR. KREMER: As far as my own personal records are concerned I can respond now.

MR. GARRISON: I want it upon the record at the proper time.

MR. KREMER: You can have it upon the record now that there is nothing, so far as I am concerned.

MR. GARRISON: I shall ask it all over again. All I want to know now is whether you can answer tomorrow morning?

MR. KREMER: Wait until tomorrow morning.

MR. GARRISON: I was trying to ascertain the fact.

THE COURT: Well, they must have such time as is reasonably necessary to respond.

MR. GARRISON: We have endeavored to ascertain what they propose to do.

THE COURT: They will try to be prepared in the morning, I suppose, or the next morning. We will now suspend until tomorrow morning at 10:00 o'clock.

WHEREUPON an adjournment was taken until Tuesday, April 17, 1917, at 10:00 o'clock a. m.

TUESDAY, APRIL 17TH, 1917.

MR. GARRISON: If your honor please, we are ready now to receive the response of the solicitors for the defendant to our notice to produce and to our supplemental notice to produce.

THE COURT: Gentlemen, are you prepared to respond this morning?

MR. KREMER: I am.

MR. GARRISON: The first item is, any and all agreements, contracts, written undertakings or written memoranda between James M. Hyde and Butte & Superior Mining Company, by whatever name said company was known, or anyone in its behalf or purporting to act for it, from January 1st, 1911, to date, or if you have not the originals of any such, then copies of the same.

MR. KREMER: We have a copy of a contract. I will furnish you not only a copy of the contract with Mr. Hyde, but, although it possibly is not called for

there, yet this is a modification of that contract, and I will give you the entire agreement. I suppose you wish to offer them. If so, then we will object. Perhaps you would like to look at them first.

MR. GARRISON: I would.

THE COURT: Have you quite a number of documents that are called for?

MR. KREMER: I think the document which Judge Garrison has now is about all we will produce. The other correspondence that we have is of the character calling for a certain size of this or that piece of machinery. There is also the matter of the expense of this Hyde litigation.

MR. GARRISON: Perhaps we had better go ahead with our notice, and if you will furnish them we will take them all and look at them.

THE COURT: Of course I do not care to sit here and watch you read. I will give you time to look over them. If you have any more that you intend to produce you might produce them. Have you others?

MR. GARRISON: Yes, sir, I will read the next item.

"Any and all letters from James M. Hyde to the Butte & Superior Mining Company (by whatever name said company was known) or to anyone in its behalf or purporting to act for it, from January 1st, 1911, to date, or if you have not the originals thereof, then copies of the same."

MR. KREMER: Judge Garrison, in that connection, you would be compelled, I think, to make that more specific. You are not entitled to all correspondence. If your request is for all correspondence as to

any particular feature, perhaps we can find it, and we will assist you to our utmost endeavor; but it is too broad as it stands. This is not a fishing expedition. We are perfectly willing to produce anything that we have that is germane to this case.

MR. GARRISON: We think that everything that James M. Hyde wrote or received commencing January 1st, 1911, about the time he left our employ and entered the employ of the defendant, that has to do with his employment or with the flotation process or with our patent or with his alleged patent is relevant to this suit.

MR. KREMER: Even if he installed a gallows frame for us?

MR. GARRISON: If it ~~that~~ was in your employment.

MR. KREMER: He was never in their employment, as far as that is concerned. I don't think you have a right to ask for everything this way. This is not a proceeding in search and seizure.

THE COURT: Of course it is understood to apply solely to their relations together.

MR. GARRISON: Anything applying to their business relations.

THE COURT: As to the matter of this concentration business under this process; it would be limited to that. Of course the notice is broader than that.

MR. KREMER: Yes, sir; it calls for everything.

MR. GARRISON: It is broader than that because we did not know what shape the matter might assume; if they admit that they had correspondence with him directed to this matter—

THE COURT: That is all the defendant will be required to produce, letters passing between Hyde and the Butte & Superior Mining Company, by whatever name it was known, relating to their operations in the concentrator and in connection with this flotation process. Are you prepared to furnish any such now?

MR. KREMER: Yes, sir, in a moment.

MR. GARRISON: The next item is, any and all copies of letters from the Butte & Superior Mining Company (by whatever name said company was known) or by anyone on its behalf or purporting to act for it, to James M. Hyde, from January 1st, 1911, to date.

THE COURT: That is, relating of course to the process and the suit that is pending.

MR. KREMER: We will produce them.

MR. GARRISON: Any and all pay rolls of the Butte & Superior Mining Company (by whatever name said company was known) on which the name of James M. Hyde appears, from January 1st, 1911, to date, and if you have not the originals, then copies thereof.

MR. KREMER: There are none.

MR. Garrison ~~KREMER~~: Any and all canceled checks of the Butte & Superior Mining Company (by whatever name said company was known) on which the name of James M. Hyde appears, from January 1st, 1911, to date.

MR. KREMER: I have three, I believe, that I will give you.

MR. GARRISON: The check books of the Butte & Superior Mining Company (by whatever name said company was known) or whoever paid out the funds

for and on behalf of the said company to James M. Hyde containing the stubs of the checks on which the name of James M. Hyde appears, from January 1st, 1911, to date.

MR. KREMER: We did not use check books; we used vouchers, and the voucher will give you the same information.

MR. GARRISON: The books of account of the Butte & Superior Mining Company (by whatever name said company was known) from January 1st, 1911, showing the account or accounts between Butte & Superior Mining Company (by whatever name said company was known) and James M. Hyde, or if there is no separate account or accounts of that character, then the books showing any and all payments to said James M. Hyde from January 1st, 1911, to date.

MR. KREMER: Those books are in New York, but I think from the data we will furnish you, that that will be covered—all that possibly might appear in the books.

MR. GARRISON: Particularly a copy or draft of a memorandum of agreement, whether the same be signed by both or one or neither of said parties, between Butte & Superior Mining Company (by whatever name said company was known) or anyone acting on its behalf or purporting so to do, and James M. Hyde, in the year 1911 relating to the erection of a flotation plant at Basin, Montana, and the arrangement with James M. Hyde concerning the same.

MR. KREMER: That is the one that I furnished to you.

MR. GARRISON: Oh, yes. Then the next is, all

letters from officials, employes, managers or superintendents to the company or to any officer or attorney of the company regarding the matter of securing the services of James M. Hyde, or securing the benefit of the knowledge of James M. Hyde regarding the flotation process of ore concentration, and any and all letters from the company to any of its officers, employes, ... or superintendents relating to the

P. 2285, L. 9, insert " or the benefit of the knowledge of James M. Hyde " after " Hyde "

ployes, managers, superintendents, counsel ...
of the company, to the attorneys or counsel for James M. Hyde, in Minerals Separation, Limited, against Hyde, or to Kremer, Sanders & Kremer, attorneys or solicitors for Hyde therein, or to J. Bruce Kremer or to Thomas F. Sheridan or to Walter A. Scott, or to Sheridan, Wilkinson, Richmond & Scott, or to Sheridan, Wilkinson & Scott, of counsel for Hyde therein, respecting or relating in any way or in any part to the conduct or management or control or direction or continuance or discontinuance or the methods or means of continuance of the defense of said Hyde therein.

MR. KREMER: There is nothing but the correspondence that passed between the counsel for Mr. Hyde, that is, between Mr. Sheridan and Mr. Scott and myself, in the preparation and conduct of the Hyde case, which of course is privileged and I don't think I ought to produce that.

MR. GARRISON: It is your response that there is no correspondence with the managers of the Butte &

Superior Company or the attorneys for the Butte & Superior Company, and the attorneys representing Hyde, on the matter; is that your response?

MR. KREMER: Yes, in this manner—I want to qualify it. Of course you understand that I am now and have been since its organization, the attorney for the Butte & Superior Mining Company, but my correspondence with Mr. Hyde and with Mr. Sheridan in connection with Mr. Hyde and the Hyde case was in the case in which I represented Mr. Hyde. So don't misunderstand me.

MR. GARRISON: I think we are entitled to the correspondence from Mr. Kremer, the attorney for the Butte & Superior Mining Company, with the attorneys appearing for Hyde; that can not be privileged.

MR. KREMER: There is no correspondence of that nature. As attorney for Mr. Hyde, I corresponded with my co-counsel, of course.

MR. GARRISON: I realize that that is privileged and I do not call for it. I do call for any correspondence with Mr. Kremer, who says he was, from the beginning of the company, the attorney for the Butte & Superior Mining Company, with whoever appeared as counsel for Mr. Hyde in the Hyde suit.

THE COURT: You say there is none such?

MR. KREMER: No, there is none, but as counsel for Mr. Hyde I had a great deal of correspondence with Mr. Scott and Mr. Sheridan, my co-counsel. I don't know of a single instance in the Hyde case where I wrote as attorney for the Butte & Superior; but afterwards, you understand, Judge Garrison, with the attor-

neys of the Butte & Superior there has been a great volume of correspondence between us in connection with that suit.

MR. GARRISON: Your honor sees my difficulty. I realize, of course, that I have no right to and I do not call for any correspondence between counsel representing the defendant Hyde; but I am entitled to all correspondence in which the writer was representing the Butte & Superior, and not representing Hyde, even though he might be the same person.

MR. KREMER: Well, there is nothing of that sort.

THE COURT: That might be, but he has answered that there is none such.

MR. GARRISON: Every time he answers he qualifies it, and that makes it difficult.

MR. KREMER: I do not want to mislead you, and yet I want to make a truthful statement, so I must qualify in order to state it correctly; I cannot answer yes or no to such a question.

THE COURT: Yes, that is true, and you must take his statement as qualified.

MR. GARRISON: I want to understand if there is a dividing line, on one side of which I am entitled, and on the other side I am not entitled, and it is difficult to draw the line, because of the dual capacity in which Mr. Kremer served these two clients.

THE COURT: There is a sort of twilight zone there.

MR. KREMER: To a certain extent, but there was a certain condition there that I am going to state later, which I think will clarify the situation, and then the way will be just as wide as a cross the street.

MR. GARRISON: I want to say this before this feature of the case is departed from: if it be the fact that the Butte & Superior Mining Company in any way directed the defense or participated in the defense of the Hyde suit, it is inconceivable that it did so without the action of someone on behalf of the Butte & Superior Company. It is possible, of course, that that participation and direction on behalf of the Butte & Superior Company was done by oral conversation, by word of mouth. If it were not, then our call is made for whatever writings there may be, and if the response of Mr. Kremer covers that, viz., that they have no copies or originals of any writing from or on behalf of the Butte & Superior Mining Company to Hyde or anyone representing Hyde with respect to the conduct of the Hyde suit, of course I will accept that, but I want it perfectly clearly understood that that is what I am asking for, and that is the thing to which I am entitled to have a response.

MR. KREMER: And that is to what I have responded and in this connection your honor will bear in mind that the record shows from the statement of Mr. Hyde, in answer to a question propounded by Mr. Williams, Mr. Hyde stated that he was paying for the defense of the suit by money furnished by the Butte & Superior Company. And the only thing, Judge Garrison, that would mark any connection at all would be that in two instances I believe a bill from Sheridan, Wilkinson & Scott and Richmond for some number of dollars—not a great deal—several thousand, all told, was delivered to me. I O. K'd. it and passed it on to

the Butte & Superior. With that exception I can answer your question that there was no common representation. I trust that I make myself clear.

MR. GARRISON: No, you do not make yourself clear to this extent: That, obviously, whatever the Butte & Superior did with respect to the contributing or directing of the payment of expenses, or what not, of the Hyde suit must be done by some one on behalf of the Butte & Superior Company. Now, if the engagement to do that was by word of mouth, then of course your response would be that there was no writing. On the other hand, if that participation was evidenced by a writing, then I have called for that writing and I am entitled to it.

MR. KREMER: There was no writing except as I say, "I have received your bill for so many dollars; I have approved it and passed it on for payment." I will furnish you that if you wish it. Aside from that, there is nothing.

MR. GARRISON: Then their payment was not as a result of any undertaking or agreement.

THE COURT: In writing, I assume? He is not under oath.

MR. KREMER: Not that I know of.

MR. GARRISON: Yes, I am asking for writing.

MR. KREMER: No, nothing. I am trying to make by statements just as I would make them if I were under oath.

MR. GARRISON: Then I am saying that the conclusion of this is that there is no writing by which the Butte & Superior undertook to do anything, financial or otherwise, with respect to the Hyde suit.

MR. KREMER: I think that statement is quite correct. So far as I know, I know of no agreement or exchange of letters which specify the manner or the amount of what the Butte & Superior shall pay, and I have no such correspondence except which you will find in these copies that I am going to furnish you. There are statements in there with respect to the expenses of this litigation; but you are now asking for correspondence between counsel.

MR. GARRISON: Or between the companies.

MR. KREMER: I have already told you I would furnish you with a part of that.

MR. GARRISON: Perhaps the matter better rest until we see what they do furnish us, and then I can take advantage of your honor's suggestion to amend my notice if there is something I have not covered, or renew my notice if I find there is something I think I am entitled to from them.

MR. KREMER: We are perfectly willing. We are not trying to avoid the furnishing of anything we have except I do not want to place myself in the position of yielding up on behalf of a client something that I have no right, professionally, to yield.

MR. GARRISON: The last item is: "All letters or copies of letters from said attorneys for Hyde or from said counsel for Hyde or any of them to the Company or any of its officers, attorneys, counsel or employes respecting or relating in any way or in any part to the conduct or management or control or direction or continuance or discontinuance of the methods or means of continuance of the defense of said Hyde in said case."

MR. KREMER: The same situation would exist there. The company had nothing to do with the initiation of the litigation nor its prosecution.

MR. GARRISON: Now, may we have a little recess to look over these papers?

MR. KREMER: I think the shortest way to do this is to give them all the papers.

THE COURT: What will this examination involve? The morning's work?

MR. KREMER: I wouldn't think it ought to take them very long.

MR. GARRISON: I should not think so. I should not think it would take us the morning.

THE COURT: We will suspend until eleven o'clock or such time as I am advised you are ready to proceed

(Whereupon a recess was taken.)

MR. GARRISON: With permission of the court, I desire to offer in evidence a copy furnished me by the defendant of an agreement made on the 22nd day of July, 1911, between the Butte & Superior Copper Company, Limited, and James M. Hyde. I understand it will be conceded that the Butte & Superior Company, Limited, was the former name of the present defendant.

MR. KREMER: It was, yes. Are you offering it?

MR. GARRISON: I do offer it, yes, sir.

MR. KREMER: To which offer the defendant objects for the reason that the document is incompetent, irrelevant and immaterial; that under the allegations of this case the proof would not be admissible for any purpose and for the further reason that there is no sufficient basis for proof under a contention of *res adju-*

dicata; for the further reason that the document upon its face shows that it is a contract by and between the defendant company and James M. Hyde acting as an independent engineer, an independent contractor, for compensation at a contract price, which is of such a character as shown by the document, to preclude the contention that Mr. Hyde was an employe or an agent of the defendant company; for the further reason that it has not been contended and it is not now contended by counsel for the plaintiff that the Butte & Superior Company is bound by the decree alleged to have been entered in the so-called Hyde case; and, the foregoing being true, it is apparent for any one of the several reasons for objection interposed that the contract is incompetent, irrelevant and immaterial for the purpose of proving any contention of *res adjudicata* or estoppel herein; and for the additional and further reason that no foundation has been laid that would permit of the introduction of testimony seeking to establish *res adjudicata* as against this defendant.

MR. GARRISON: Does your honor want to hear me on that?

THE COURT: Do you want to argue it?

MR. KREMER: If we are going to reargue hereafter all of the questions, I don't want to waive the ruling now upon objection, but I take it from my past experience that we will have to reargue all of these over again.

THE COURT: I take it so. As a matter of course, if anything is not obviously incompetent, irrelevant nor immaterial the court will admit it for the sake of the

record and for the sake of a decision in a higher court, where it is to be assumed such a case will go. If we exclude anything, or have made any mistake in connection with the admission of any evidence, the appellate court may have to send it back for retrial, but if it is in the record they can dispose of the case.

MR. KREMER: I assumed your honor's ruling would be *pro forma*.

THE COURT: As far as the pleadings are concerned, I don't understand that they would be obliged to plead it at all, although they have pleaded it probably after a fashion that might be criticised. It is the ordinary question relating to the title to a patent, a valid patent that they claim is infringed by the defendant. Now, the defendant sets up that the patent is not valid. That of itself, without pleading any further adjudication, would permit the introduction by the plaintiff of a former adjudication to estop the defendant from interposing that defense. I am speaking now of the ordinary rules of pleading and I do not suppose there is anything peculiar to patent litigation as to the pleading. While a rule exists to plead former adjudication in patent proceeding I take it it is largely done to satisfy the old equity rule in cases where they are seeking a preliminary injunction. If A has quieted his title against B to a piece of property and afterwards sues B in ejectment, he simply alleges that he is the owner, does not allege that he has secured a prior adjudication of title against B. If B attacks his title in any system of pleadings or replication, then it would be necessary for A to plead the estoppel in the replication.

No replication is necessary in equity proceedings in the Federal Court. Hence he can introduce it in evidence without having pleaded it. So I take it in this case it is to estop you from the defense of lack of novelty that you plead, and of course the plaintiff introduces it as part of its case in chief to obviate the necessity, if he makes his claim good, of the court first hearing the defense of the defendant, and afterwards taking note of the estoppel. The objection is partly based upon the assertion that there is no claim that the defendant is bound by the Hyde decree. I don't understand that that is the attitude of the plaintiff.

MR. GARRISON: Just the contrary.

THE COURT: If it was, of course, as far as estoppel is concerned it would be immaterial.

MR. KREMER: Do I understand that it is your contention, Judge Garrison, that the Butte & Superior Mining Company is bound by the decree in the Hyde case and that the decree in the Hyde case settles the controversy between the parties plaintiff and the defendant Butte & Superior Mining Company?

MR. GARRISON: Does the court desire me to answer that now?

THE COURT: Why, you may.

MR. GARRISON: I do not want to take the time of the court unless the court wants me to.

THE COURT: You may answer it at this time, to make your position clear to counsel.

MR. GARRISON: Our contention is that Hyde had such a relationship to the defendant company that when they undertook the conduct of the defense of the

Hyde suit, the findings with respect to the validity of the patent and what constituted infringement in the Hyde suit estopped them from re-litigating these questions in this suit. We do not, of course, contend that the decree binds them in the sense that, based on that decree, we could enjoin them or based on that decree we could recover damages, profits or costs from them. We do ~~not~~ contend that they are estopped by reason of their conduct from re-litigating in this suit that which they elected in the conduct of the Hyde suit to be caused to be litigated and settled therein as to the validity and character of an action which constituted an infringement of a valid patent.

THE COURT: The court so understands.

MR. KREMER: They are taking the position then, as I understand it, that we are bound in part by the Hyde decree.

THE COURT: The court understands it so. That is to say you are debarred and estopped from further litigating the validity of the patent.

MR. KREMER: Then the res adjudicata only applies to a part.

THE COURT: Well, that might be a legal proposition. At this time the court of course will overrule the objection and the documents will be received.

The contract admitted in evidence and marked PLAINTIFF'S EXHIBIT 1.

MR. GARRISON: I now offer in evidence memorandum of agreement, a copy of which has been furnished us by the defendant dated the 26th day of October, 1911, between James M. Hyde and Butte & Su-

perior Company, Limited, by A. B. Wolvin, president.

THE COURT: Is this another agreement?

MR. GARRISON: This is a modification, sir, of the exhibit 1.

MR. KREMER: To which the defendant objects for the reasons hereinbefore set forth, and for the reason that it is incompetent, irrelevant and immaterial for any purpose whatsoever.

THE COURT: The objection will be overruled.

MR. KREMER: Exception.

Document admitted in evidence and marked PLAINTIFF'S EXHIBIT 2.

MR. GARRISON: I now offer in evidence a copy of letter dated September 21st, 1911, addressed to James M. Hyde, Basin, Montana, unsigned, with typewritten initials indicating it to have been dictated by M. W. A., and we understand that the defendant concedes that this was Maxwell W. Atwater, the then superintendent of the defendant company.

THE COURT: I understand you are offering this as having been produced by the defendant upon your notice?

MR. GARRISON: Yes, sir; they were furnished us by the defendant.

MR. KREMER: Yes, certainly we furnished them.

THE COURT: Well, it may be received under your original objection.

MR. KREMER: Yes, sir; I was simply trying to ascertain if there was any additional objection. I make simply the same objection as to the last.

THE COURT: Objection overruled.

Defendant excepted.

Letter admitted in evidence and marked PLAINTIFF'S EXHIBIT 3.

(It was thereupon stipulated that the official reporter should make copies of all exhibits and that the originals should thereupon be returned to the party producing them).

MR. GARRISON: I now offer in evidence a letter furnished by the defendant, signed James M. Hyde, addressed to J. L. Bruce, dated April 24th, 1913. I understand it is stipulated by the defendant that J. L. Bruce was at that date the manager of the defendant corporation.

MR. KREMER: Yes, sir. We make the same objection.

THE COURT: Objection overruled.

Defendant excepted.

Letter of April 24th, 1913, admitted in evidence and marked PLAINTIFF'S EXHIBIT 4.

MR. GARRISON: I now offer in evidence letter signed M. B. MacKelvie, president, on the paper of the Butte & Superior Copper Company, Limited, dated July 2nd, 1913, addressed to J. L. Bruce, manager Butte & Superior Mining Company, Limited, O'Rourke Estate Building, Butte, Montana.

MR. KREMER: The same objection.

THE COURT: Objection overruled.

P. 2297, after L. 27, insert, "Letter dated July 2, 1913, admitted in evidence and marked Plaintiff's Exhibit No. 5."

dated January 5th, 1911, and over the 1911 is a pencil question mark, and under it in pencil 1912, addressed to M. W. Atwater, Butte, Montana. I understand it is conceded by the defendant that the proper date is 1912. Mr. Atwater was not here in 1911, but at that date in 1912, the defendant concedes that M. W. Atwater was the superintendent of the defendant corporation.

MR. KREMER: The notation was put on there by us, was it?

MR. GARRISON: Oh, yes. We have not touched any of your exhibits. Mr. Hyde was not in this country in March, 1911; he was in London at our office.

MR. KREMER: All right; it was March, 1912. I make the same objection.

THE COURT: Objection overruled.

Defendant excepted.

Letter dated January 5th, 1911, which should be 1912, admitted in evidence and marked PLAINTIFF'S EXHIBIT 6.

MR. GARRISON: I offer in evidence a copy of letter furnished us by the defendant signed with the initials J. L. B., manager, dated May 17th, 1913, addressed to Mr. D. C. Jackling, vice president and general manager of the Utah Copper Company, Salt Lake City, Utah. I understand it is stipulated by the defendant's attorney that the initials J. L. B. stand for J. L. Bruce, and that he was at that time the manager of the Butte & Superior Mining Company, the defendant.

MR. KREMER: Yes. We make the same objection.

MR. GARRISON: Will it be stipulated upon the record that upon the date May 17th, 1913, Mr. D. C. Jackling was vice president of the defendant company?

MR. KREMER: I don't know whether he was on that date or not.

MR. WILLIAMS: The records of the company will show that.

MR. KREMER: To this letter I make the additional objection that it is incompetent, irrelevant and immaterial for any purpose whatsoever. The file furnished counsel was a file containing all of the correspondence that had transpired between any of the parties, but I will submit this letter to your honor at this time. I don't think it is relevant.

MR. GARRISON: Is it your objection that it is addressed to Mr. Jackling of the Utah Copper Company.

MR. KREMER: That is one of the objections.

MR. GARRISON: Well, I will call Mr. Bruce.

THE COURT: No, you need not do that; you can make it good later on, unless you think you cannot.

MR. GARRISON: I was going to get Mr. Bruce to say that it was addressed to Mr. Jackling because he was the vice president of the defendant company.

THE COURT: You can establish that later, unless you say you cannot show it.

MR. GARRISON: I say I can show it to the court now, I can show that Mr. Jackling was connected with the defendant company.

MR. KREMER: And I object that it has nothing whatever to do with this case, and is incompetent, irrelevant and immaterial. There is no dispute in this case and never has been—and there is no issue as to this.

THE COURT: It is a circumstance in this case. Of course it does not identify the service rendered.

MR. GARRISON: They will concède that the service rendered was in the Hyde suit.

MR. KREMER: I will further concede that the record shows, brought out by the plaintiff in this case, that Mr. Hyde had sold his rights to a certain patent, and in consideration for those rights, the expense of this litigation was being paid, so there is no controversy about that.

THE COURT: I know, but are they to be bound by Hyde's statement?

MR. KREMER: Surely they are, if they bring out a matter of that sort, unless they want to refute it, but they cannot refute it by ~~arg~~augumenting the truth of it.

THE COURT: I think we will let this go in; this may be one of the circumstances. I don't remember, myself, what is in the record, of course. The objection will be overruled.

Defendant excepted.

MR. GARRISON: I understand that it is conceded by counsel for the defendant that the case re-

ferred to in exhibit 7 was the case of Minerals Separations Limited against James M. Hyde, the letter being dated May 17th, 1913.

MR. KREMER: We will endeavor to ascertain that for you, just what bill it was. We will make a note of it and look it up.

Letter dated May 17th, 1913, admitted in evidence and marked PLAINTIFF'S EXHIBIT 7.

MR. GARRISON: I offer in evidence a letter furnished us by the defendant from M. B. MacKelvie dated July 28th, 1913, addressed to Mr. J. L. Bruce, Butte, Montana. I understand it is stipulated by the defendant that at that time Mr. J. L. Bruce was manager of the defendant corporation.

MR. KREMER: We make the same objection.

THE COURT: Objection overruled.

Defendant excepted.

MR. GARRISON: Will you stipualte that on the 28th of July 1913, Mr. M. B. MacKelvie was the president of the defendant corporation?

MR. KREMER: Yes.

Letter dated July 28, 1913, admitted in evidence and marked PLAINTIFF'S EXHIBIT No. 7A.

MR. GARRISON: I offer in evidence letter which is referred to in the letter just offered, which enclosed letter or copy thereof is signed James M. Hyde, and is addressed to Mr. M. B. MacKelvie and is dated July 15th, 1913. I offer these two as one exhibit.

MR. KREMER: The same objection, and for the further reason that the last offer is of a typewritten copy of a letter signed by Mr. Hyde, and for that reason is not admissible. It is not identified as having been written by Mr. Hyde.

THE COURT: Objection overruled.

Defendant excepted.

Letter dated July 15th, 1913, admitted in evidence and marked PLAINTIFF'S EXHIBIT 8.

MR. GARRISON: I now offer in evidence a letter furnished by the defendant signed F. R. Wicks, mill superintendent, addressed to Mr. S. E. Janney, manager of mills, Utah Copper Company, Salt Lake City, Utah, dated September 16th, 1913.

MR. KREMER: This is objected to on the ground that it is incompetent, irrelevant and immaterial, and for the additional reason that it shows no connection whatsoever with Mr. Hyde or with the company, nor does it purport to connect Mr. Hyde in any way with the company or its operations by any one in authority so to do.

THE COURT: Is there anything in it relating to this matter.

MR. GARRISON: Oh, yes, sir.

THE COURT: The objection will be overruled. Of course if it should develop that it is incompetent, the court will rule it out later.

MR. KREMER: Of course I understand that your honor holds that we may renew all these objections as to competency later if necessary?

THE COURT: Yes.

Letter of September 16, 1913, admitted in evidence and marked PLAINTIFF'S EXHIBIT 9.

MR. GARRISON: I offer in evidence letter furnished us by the defendant, signed M. B. MacKelvie, to Mr. Allen H. Rogers, care of Butte & Superior Copper Company, Limited, Butte, Montana, dated March 1st, 1913, together with an enclosure, namely a statement addressed to the auditor calling upon him to pay James M. Hyde a certain specified sum of money, under date of January 29th, 1913. I understand that it is stipulated by the defendant that at that time Mr. M. B. MacKelvie was president of the defendant corporation.

MR. KREMER: You said this was a statement to the auditor; it is a bill.

MR. GARRISON: It is a statement to the auditor exactly as I said. It is addressed to the auditor.

MR. KREMER: By James M. Hyde. To that we make the same objection.

THE COURT: Objection overruled.

Defendant excepted.

Letter of March 1st, 1913, together with voucher or bill of January 29th, 1913, admitted in evidence and marked PLAINTIFF'S EXHIBIT 10.

MR. GARRISON: I offer in evidence a paper headed Butte & Superior Copper Company, Limited, Butte, Montana, March 6th, 1913, containing language as follows: "Voucher payable to James M. Hyde.

$601.70. Approved for payment," and with an ink signature "C. M. Everett."

MR. KREMER: To which we object for the reason previously stated, and for the further reason that it does not prove any issue here.

THE COURT: Objection overruled.

Defendant excepted.

Paper dated March 6th, 1913, admitted in evidence and marked PLAINTIFF'S EXHIBIT 11.

MR. GARRISON: I now offer in evidence a voucher check of the Butte & Superior Copper Company, Limited, signed by C. M. Everett, "Special." Addressed to the First National Bank of Butte, Montana, dated March 6th, 1913, for $601.70, payable to the order of James M. Hyde, and endorsed in ink, "James M. Hyde." With various marks showing that it was paid—various cancellations of the bank.

MR. KREMER: We make the same objection.

THE COURT: Objection overruled.

Defendant excepted.

Voucher dated March 6, 191~~5~~3, admitted in evidence and marked PLAINTIFF'S EXHIBIT No. 12.

MR. GARRISON: I offer as one exhibit papers described as follows: A typewritten paper headed "Expense account of James M. Hyde in attendance on Mill and Patent Suit, March and April, 1913," with items aggregating $325.65. A paper entitled "Audit bill, Butte & Superior Copper Company," ad-

dressed to the auditor, calling upon him to pay James M. Hyde that sum of money already mentioned under date April 30th, 1913. Then a paper headed "cash voucher" payable to James M. Hyde for the same sum of money, dated March 2nd, 1913.

MR. KREMER: The same objection.

THE COURT: Objection overruled.

Defendant excepted.

> Three papers, expense account, audit bill and cash voucher admitted in evidence and marked PLAINTIFF'S EXHIBIT 13.

WHEREUPON an adjournment was taken until 2:00 o'clock P. M. of this day, Tuesday, April 17th, 1917.

Tuesday, April 17, 1917, 2:00 P. M.

Court convened pursuant to adjournment, all parties present; whereupon the following proceedings were had:

MR. WILLIAMS: I will now complete a few matters. This stipulation has been agreed upon and I will read it into the record. It is hereby stipulated that the concentrates which were contained in car So. 15679 at Bartlesville, Oklahoma, on September 18th, 1913, referred to in the deposition of Hugh N. Line, given in behalf of plaintiff, were the concentrates produced by the defendant in its flotation plant. It is further stipulated that subsequent to January, 1912, and prior to the commencement of this suit, the de-

fendant carried on a process of concentrating ore wherein the minerals were separated from gangue by agitating the ore in water, containing oleic acid in the proportion less than twenty pounds to the ton or ore, to form a froth, and separating the froth by flotation, and that the defendant also used heat and sulphuric acid in such process.

I now offer in evidence various articles which were identified by witnesses during the taking of the depositions and were marked for identification by the examiner at the time of taking these depositions.

The first article marked for identification seal of car is offered in evidence as plaintiff's exhibit 14.

MR. KREMER: I don't think I shall object to any of these.

MR. WILLIAMS: You have stipulated that this car contained your concentrates. This is the seal of the car.

MR. KREMER: To save time, I don't think there is any objection to any of these.

Seal admitted in evidence and marked PLAINTIFF'S EXHIBIT 14.

MR. WILLIAMS: This slip of paper marked for identification, "Memorandum of number of car" offered in evidence as plaintiff's exhibit 15.

Memorandum admitted in evidence and marked PLAINTIFF'S EXHIBIT 15.

MR. WILLIAMS: The specimen of concentrates and the bag in which it was put and forwarded, which

was marked for identification "defendant's concentrate No. 2" offered in evidence as plaintiff's exhibit 16.

Bag admitted in evidence and marked PLAINTIFF'S EXHIBIT 16.

MR. WILLIAMS: The specimen of concentrate after some treatment described by the evidence marked for identification "original Chandler sample" offered in evidence as plaintiff's exhibit 17.

Bottle containing concentrates admitted in evidence and marked PLAINTIFF'S EXHIBIT 17.

MR. WILLIAMS: I may say generally that these depositions and these exhibits complete that part of the testimony which was described in the affidavits which were presented to your honor on the order to show cause and motion for preliminary injunction and give the details and particulars of the act which your Honor then held proved infringement with an oil proportion which was much less than one per cent, and then there is the general stipulation connecting up these concentrates with the defendant, and the general statement as to operation, concludes the prima facie case as to infringement.

MR. KREMER: Counsel having concluded his prima facie case as to infringement we now move to strike out all the testimony with reference to the infringement for the reason that the act of infringement has not been shown or proven by competent testimony.

THE COURT:. Of course the court has not all the testimony in mind, only what is inthese depositions. For the purpose of the record the motion will be denied.

Defendant excepted.

MR. KREMER: We now move the court to strike out all of that portion of the statement of counsel as to the showing of infringement or showing that defendant used less than one per cent. of oil, insofar as the same refers to any statement contained in the affidavits on the Hyde hearing, and we move particularly to strike out from consideration in the record all affidavit testimony in connection with the infringement, if the same is to be considered as to the question of whether or not there has been an infringement.

THE COURT: Of course the statement of counsel is not evidence. You move to strike out his statement?

MR. KREMER: Yes, sir; it was offered in an evidentiary capacity; it was an explanation of a certain deficiency, and we do not want the statement to stand unchallenged, because somebody might say that it was stated in open court and not challenged.

THE COURT: Counsel did not intend that.

MR. WILLIAMS: Certainly not; it was merely an explanation.

MR. KREMER: I know, but it is sometimes dangerous to allow those things to stand unchallenged.

THE COURT: I understand that. And your other motion?

MR. KREMER: Yes, I object to the affidavit

MR. WILLIAMS: I did not offer the affidavit in evidence; I merely called attention to the fact that the affidavits were repeated in the depositions; that the depositions contained the things that were shown in the affidavits.

MR. KREMER: I thought you were considering the affidavits upon the application for the preliminary injunction as testimony in this case, to be frank with you.

MR. WILLIAMS: Not for a moment.

THE COURT: The court does not think any ruling is required.

MR. KREMER: That is all right; I wanted to be sure that he was not considering those as testimony in the case.

THE COURT: That is perfectly proper under the circumstances.

MAXWELL W. ATWATER, called as a witness for plaintiff, after being duly sworn, testified as follows:

DIRECT EXAMINATION,

BY MR. GARRISON:

Q. 1. Where do you reside?

A. Basin, Montana.

Q. 2. What is your business?

A. Mining engineer.

Q. 3. Were you connected with the Butte and Sup-

erior Mining Company, whatever its then title was, in the year 1911?

A. I was connected with the Butte & Superior Mining Company, yes, sir.

Q. 4. Say in the month of March 1911, and from then on, what was your position with that company?

A. General superintendent.

Q. 5. How long did you continue general superintendent?

A. Until February, 1913.

Q. 6. Do you know James M. Hyde?

A. I do.

Q. 7. Who conducted the negotiations with Hyde, arranging for the installation of an ore flotation concentrating plant for the Butte & Superior Mining Company?

A. I did.

Q. 8. When were those arrangements made?

A. In the summer of 1911.

Q. 9. Between you and Mr. Hyde?

A. Yes, sir.

Q. 10. Was anything said by either of you at that time concerning the possibility of litigation over the question of installation of an ore flotation concentrating plant by the Butte & Superior Mining Company?

MR. KREMER: We object to this.

MR. GARRISON: You can't object when I say was anything said; he might answer "no". It is foolish to object until he has answered yes or no.

MR. KREMER: I will do these things as I think they ought to be done. I object for the reason that any statement of whatsoever kind and character made by Mr. Hyde in connection with litigation or by Mr. Atwater to Mr. Hyde in connection with litigation would be incompetent, irrelevant and immaterial and not binding upon the defendant in this action. Mr. Atwater's authority, under the rights of superintendent not being of such a character as to justify charging the defendant company with any statement made by either Mr. Hyde or Mr. Atwater or any kind or character in connection with litigation. It would in nowise be binding on this defendant company.

THE COURT: The question being merely preliminary, the objection will be overruled.

Defendant excepted.

A. Yes, sir.

Q. 11. Which one of you made any statement about that matter?

MR. KREMER: The same objection, and for the further reason that any agreement between this company and James M. Hyde is embodied in the written agreements here on file and presented as exhibits in this case by the plaintiff, and any statement looking to the preliminary arrangement would be entirely improper and incompetent for any purpose, being presumed to have been merged in the written contract.

THE COURT: Well, that might be true between Hyde and the company, but not as to a third party. The objection is overruled.

MR. GARRISON: So as to make the matter straight, may I call the court's attention to this: the agreement called for here would properly, of course, cover, as the language does cover, all agreements between the defendant corporation and Hyde concerning this subject matter. They have produced no written agreement concerning the conduct, control, payment of expenses of, or other participation in the defense of the Hyde suit, or in any prospective litigation in which Hyde might become involved by reason of his employment in this business; therefore the rule cannot possibly apply that we are relegated to the written agreement, since the written agreement is entirely silent. Now, there may be a written agreement which they have not produced, because in Exhibit X-5 Mr. MacKelvie, the president of the company, states as follows: "I have had in my mind the outcome of the suit of Minerals Separation Company against Hyde, but the contract with Hyde was entered into practically with that knowledge of this pending litigation, and later the company made an agreement with Hyde to defend this suit for him, and at that time did not ask for any modification of the then existing contract."

Mr. MacKelvie said they made an agreement to defend the Hyde suit for him. If they did, and that is in writing, we are entitled to it. If they did not, then the objection that we have no right to get the contents of an agreement because it is in writing, falls of its own weight.

Maxwell W. Atwater.

THE COURT: You may proceed.

Defendant excepted.

A. Hyde first spoke to me about possible litigation.

Q. 12. What did Mr. Hyde say?

MR. KREMER: Objected to for the reason that it is hearsay, incompetent, irrelevant and immaterial, not binding upon this defendant. Any statement made by James M. Hyde would not be chargeable as against this defendant. It is strictly hearsay.

THE COURT: If the proof in that direction is not sufficient to make this conversation competent, the court will disregard it in making up its decision. At this time the objection will be overruled.

Defendant excepted.

A. Hyde said that if we engaged in the concentration of ores by flotation under his advice, that we would doubtless be sued by the Minerals Separations Company.

Q. 13. What else did he say about that?

A. You mean in connection with the arrangement which he and I had made?

Q. 14. Yes, in connection with the arrangement that you made with him.

A. He asked as part of our agreement that the company stand the expense of any suit that might be brought against him.

Q. 15. Anything else?

A. I don't remember anything more at that time.

Maxwell W. Atwater.

Q. 16. What did you say in response to that?

A. Well, I said that I would, as far as I was concerned, agree to it and would recommend that it be done.

Q. 17. Did Mr. Hyde at that time make any mention to you of any patents of his own?

MR. KREMER: I object to that as incompetent, irrelevant and immaterial, hearsay testimony and in no way binding upon this defendant, the witness upon the stand not shown to have been vested with any authority to act or in a contractual capacity for the defendant and the statement made by Mr. Hyde to him was nothing more than reciprocal statements of strangers to this defendant.

THE COURT: The ruling is the same as the last. Objection overruled.

A. He made no mention of any patents of his own at that time.

Q. 18. MR. GARRISON: Did Mr. Hyde ever make any statement concerning any patents of his own or any intention upon his part to take out any patents?

MR. KREMER: I object to that for the same reason, and the additional reason that it is incompetent, irrelevant and immaterial for any purpose whatever, whether he did or did not.

THE COURT: Objection overruled.

MR. KREMER: Exception.

A. Well, later in the year.

Q. 19. MR. GARRISON: Well, just answer yes or no; he did or he did not.

Maxwell W. Atwater.

A. Yes, sir, he did.

Q. 20. Now, when did he make any such statement to you?

MR. KREMER: The same objection.

THE COURT: Objection overruled.

MR. KREMER: Exception.

A. Later on in the year in October or November of 1911.

Q. 21. MR. GARRISON: And where were these statements made; where was this conversation held?

A. In Butte or in Basin.

Q. 22. And at that time had the suit of Minerals Separation Limited against James M. Hyde been commenced?

A. Yes, it had.

Q. 23. Now, what did Mr. Hyde say concerning any patent of his own or his intention with respect to taking out any patents of his own?

A. He said he was going to take out certain patents covering the particular points in which his process differed from the Minerals Separation process.

Q. 24. Well, what did you say to him?

A. I asked him why he took out patents on a process which he considered the patents which had already existed were of no value.

Q. 25. And to what process did you then refer?

MR. KREMER: I move to strike out the statement of the witness as entirely hearsay, volunteered statements.

THE COURT: Objection overruled.

MR. KREMER: Exception.

MR. GARRISON: Please read the question.

(Question read as follows: "And to what process did you then refer?")

MR. GARRISON: And to what process did you refer? You said to him—you had asked him why it was he contemplated taking out patents where he considered those that had already been taken out to be void. Now, I want to know to what patents you referred in that connection?

A. Minerals Separation Company patents in suit.

Q. 26. In suit. And what was his answer?

A. He answered that he had been advised to do so.

MR. KREMER: We interpose the same objection.

THE COURT: The like ruling.

MR. KREMER: Exception.

A. He answered that he had been advised to do so by his counsel.

Q. 27. MR. GARRISON: During the time that you were the general manager—that was the title?

A. Superintendent.

Q. 28. During the time that you were superintendent from the date that you have mentioned in 1911 down to the time that you ceased your connection with the company in February of 1913, did you at any time pay moneys to James M. Hyde on behalf of the Butte & Superior Company, the defendant?

A. Yes.

Q. 29. Did you pay him a flat sum of money per day or did you pay him moneys made up of items of expenses, or both?

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A. We paid him so much a month.

Q. 30. Was that so whether he was here, at Basin or whether he was traveling away somewhere else?

A. I believe that only applied while he was working in Basin.

Q. 31. And while he was away—

A. Or here.

Q. 32. (Continuing)—somewhere else; what items did you pay him for?

A. His expenses.

Q. 33. The company paid him his expenses?

A. The company paid his expenses on trips away in that year.

Q. 34. Did you continue to pay him sums of money —to pay sums of money to Hyde during the whole time that you were connected with the company down to February, 1913?

A. No.

Q. 35. Did you—When did you cease paying him moneys?

A. I think when he left Basin.

Q. 36. And about when was that?

A. That was—why I think he received a salary after he left Basin. I will correct that. While he was working at Butte on the flotation plant here.

Q. 37. At Butte.

A. At Butte. I believe he still received so much a month.

Q. 38. Yes. Just to make that clear, the first plant that was erected, was erected at Basin?

A. Yes.

Q. 39. And then another one was erected at Basin?

A. Right.

Q. 40. And then another one was erected at Butte.

A. Yes.

Q. 41. All by the Butte & Superior Mining Company, the defendant?

A. Yes.

Q. 42. Were these payments made to Hyde in the form of voucher checks, the signature of which would be a receipt?

A. Yes, sir.

Q. 43. And where were these voucher checks, after they came back, deposited—where were they then kept?

A. The checks were drawn on the First National Bank of Butte and were returned to the Butte & Superior Copper Company's office in Butte.

Q. 44. And, so far as you know, they are still there?

A. Yes, so far as I know.

Q. 45. Was he paid expenses incurred by him while attending the trial, the taking of evidence, consultation with counsel, and so forth, in the suit of Minerals Separation Company Limited against James M. Hyde?

A. I don't know.

Q. 46. The vouchers would have to show that. would they?

A. Yes, sir.

Q. 47. He was, however, as I understand it, paid

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expenses when away from Basin after you made the arrangement with him?

A. On his trips away from Basin to Duluth or New York and I believe to London, but I am not sure about that. He rendered statements of expenses.

Q. 48. Duluth at that time was the head office of the company was it not?

A. Yes.

Q. 49. And what had New York to do with the company—was there a branch office there is all I want to know?

A. In 1911?

Q. 50. Yes.

A. No.

Q. 51. Was there in 1912?

A. Yes, sir—there wasn't a branch office; it was the head office.

Q. 52. They had moved it from Duluth to New York?

A. In 1912, I believe, yes, sir.

Q. 53. Was that when Mr. Jackling became connected with the company?

MR. KREMER: I object to that as incompetent, irrelevant and immaterial; not a thing on earth to do with the question.

THE COURT: Overruled.

MR. KREMER: Exception.

A. Yes.

Q. 54. MR. GARRISON: And did Mr. Jackling remain with the company down to the time that you left?

A. Yes.

Q. 55. Now, you have said that there were three ore separation flotation plants erected during the time that Hyde was engaged in this business, one at Butte. When was that erected, generally speaking?

A. The one at Butte?

Q. 56. I beg your pardon. I mis-spoke myself. The first one at Basin?

A. In July, 1911, the first one.

Q. 57. That was erected with moneys of the Butte & Superior Mining Company, the defendant?

A. Yes, sir.

Q. 58. And the ore concentrated in it belonged to whom?

A. Belonged to the Butte & Superior Company.

Q. 59. And the concentrates belonged to whom?

A. To the Butte Superior Company.

Q. 60. Do those same answers remain true as to the second plant erected at Basin and the third plant erected at Butte?

A. They remain true.

Q. 61. Did you voluntarily appear here today or come under subpoena?

A. I was subpoenaed.

MR. GARRISON: You may take the witness.

CROSS EXAMINATION

BY MR. KREMER:

X-Q. 62. When were you subpoenaed?

A. Monday morning, yesterday morning.

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X-Q. 63. Did you make any per diem arrangements for compensation with the Minerals Separation?

A. I made no arrangements. I receive a fee.

X-Q. 64. How much of a fee?

A. $1.50 a day.

X-Q. 65. $1.50 a day. Did you receive the same fee for testifying for the Mineral Separation in the Miami case?

MR. GARRISON: I object to that as absolutely irrelevant and immaterial what he received in some other case.

MR. KREMER: We have a right to show his interest.

THE COURT: Just to show under the circumstances if there is any interest or feeling. You may answer. I understand the Miami case was a case by this plaintiff involving the same process.

MR. GARRISON: Yes, but not against these defendants, unless they concede it. Do you concede that you were the defendant of the Miami case?

MR. KREMER: I have asked the witness a question.

THE COURT: The court should not interject any understanding. I will leave you show it by evidence. Proceed.

A. I received quite a different compensation at the Miami trial.

MR. KREMER: How much compensation did you receive for testifying for this plaintiff in the Miami case?

MR. GARRISON: I object. How can this be relevant or material in this suit unless this defendant concedes that they were the defendant or unless they participated in the defense of the Miami case.

THE COURT: It would be only to show the relation that they had or might exist or did exist between the plaintiff and this witness. You asked him if he had been subpoenaed in order to show that he was here not voluntarily. Now, I think they had a right to go a little farther, but I don't think the court will insist on this point. He can assume, I think, that there was a good substantial fee. The objection will be sustained.

MR. KREMER: Exception.

X-Q. 66. How long were you on the Miami case in Wilmington, under retainer from the Minerals Separation?

A. About six weeks.

X-Q. 67. Had you, previous to that time, been under retainer from the Minerals Separation?

MR. GARRISON: I object. I can't see how it is relevant or material in this suit.

THE COURT: To show the relation between the parties, whether he has reason to feel very friendly. He may answer. Objection overruled.

A. Do you mean under retainer?

MR. KREMER: I mean per diem arrangement, like all experts—most of them, rather?

A. On account of litigation, do you mean, or how?

X-Q. 68. In any capacity, Mr. Atwater. Why quibble about it?

MR. GARRISON: I object to that utterly unnecessary statement of counsel.

THE COURT: Yes, he may answer.

A. No.

X-Q. 69. MR. KREMER: Had never been employed by them before the Miami case?

A. No.

X-Q. 70. Did you seek employment from them in the Miami case or did they approach you?

MR. GARRISON: I object, if your honor please, it does seem to me we are getting very far afield here.

THE COURT: He may answer that question. The objection is overruled.

A. They asked me to testify.

X-Q. 71. MR. KREMER: In discussions with you, your testimony in that case and this, did they suggest to you that in view of the fact that you had previously been connected with the Butte & Superior as a matter of agent for the Butte & Superior that your testimony would be valuable to them?

MR. GARRISON: I object. There is an assumption in that question that is utterly unwarranted by anything in the proof.

THE COURT: Objection sustained.

MR. KREMER: Exception.

X-Q. 72. Did you communicate to them or did they solicit from you the fact that you had been employed by this defendant in the past?

MR. GARRISON: I object. That is based on an assumption.

MR. KREMER: It seems to me here is a man that goes upon the stand and declares he was the general manager and contractor for the defendant; he says he comes here under subpoena. The fact is now disclosed he has been under retainer and has been compensated by the Mineral Separations Company in past suits. We believe—we not only have a right, it seems to me, to show that this witness is here under a friendly relationship with the Minerals Separation Company, but if we can to show that his employment was sought by reason of the fact that he had had some previous connection with this defendant—

MR. GARRISON: My objection don't go to that point. It is the form of the question, it seems to me.

MR. KREMER: No doubt the witness can answer it.

THE COURT: Read the question.

(Question read.)

THE COURT: I think you better change the form a little. It is rather awkward as it is—not to dictate your language at all.

MR. KREMER: I will propound another.

MR. GARRISON: Make it clear.

MR. KREMER: It is as clear as I can make it, but I will attempt to do better.

X-Q. 73. In arranging to engage you in either of these cases or in the Miami case, confining it to one, did they suggest to you that they desired your testimony because you had previously been employed in connection with flotation matters?

MR. GARRISON: I object as utterly immaterial and irrelevant.

THE COURT: What are you trying to arrive at, whether he volunteered or whether they solicited his services?

MR. KREMER: Exactly.

MR. GARRISON: Confining himself to the Miami case.

MR. KREMER: I was going to supplement that by asking with respect to this case, in order to prevent the equivocal statement that "they employed me before I was subpoenaed in this case". The witness has already testified he was subpoenaed here. He didn't come voluntarily.

THE COURT: Read the question.

(Question read as follows: "In arranging to engage you in either of these cases or in the Miami case, confining it to one, did they suggest to you that they desired your testimony because you had previously been employed in connection with ~~flotations~~ flotation matters?")

MR. KREMER: I wanted to find out whether he communicated to them the fact that he was employed by the Butte & Superior and solicited employment from them, or whether they suggested to him by reason of his employment by the Butte & Superior they would like to engage him.

THE COURT: Put that in the form of a question.

X-Q. 74. MR. KREMER: Did you solicit employment from the Minerals Separation, stating to

them that you had previously been employed by the Butte & Superior Company?

MR. GARRISON: In what case?

MR. KREMER: In any case.

MR. GARRISON: I object, if your honor pleases, to the question of any case.

THE COURT: Let him finish the question.

MR. KREMER: (Continuing)—or did they suggest to you that they desired to employ you for the reason of the fact that you had been in the employ of the Butte & Superior Company?

MR. GARRISON: That is based on an assumption.

MR. KREMER: No assumption. It is a plain and simple question as to whether a certain condition is true.

THE COURT: It is obvious that either they must have solicited him to testify for them or he must have volunteered.

MR. KREMER: No, that is not the question.

THE COURT: I think not.

MR. GARRISON: There is a question with an assumption in it, if your honor will read the question. They are making him their witness on this, and they are not asking him to state facts or to answer questions that may be answered yes or no. In a question like that it makes it impossible to do anything but confuse the answer. I have no objection to his asking a direct question.

THE COURT: I think they are double questions,

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as a matter of fact. Single them out. The objection will be sustained. Put another question.

MR. KREMER: That is what I did before and counsel objected, and I conformed to the ruling of the court.

X-Q. 75. Did you solicit employment from them upon the representation that you had been previously employed by the Butte and Superior?

A. No.

THE COURT: That again is two questions; it is like the old question: "Have you quit beating your wife?"

MR. KREMER: I will reform the question. Q. Did you represent to the Minerals Separation in your discussion with them about employment that you had previously been connected with the Butte & Superior?

MR. GARRISON: I object to that question; there is an assumption in there that he represented something to them.

MR. KREMER: It does not matter whether he did or not. He can answer.

Objection overruled. Plaintiff excepted.

X-Q. 76. Answer yes or no.

A. No.

X-Q. 77. Did they suggest to you that they desired your services for the reason—by reason of the fact that you had been in the employ of the Butte & Superior Company?

A. No, they did not.

X-Q. 78. Did you testify as an expert in the Miami case?

A. (Hesitating)

THE COURT: Will you answer?

A. Yes, I did.

X-Q. 79. Did you testify in matters appertaining to the use of oil flotation, other than those things which you had observed during the time during which you operated the Butte & Superior mill?

A. (Hesitating)

THE COURT: Well, there is no objection.

MR. GARRISON: If your honor wants to go on with this I am not going to object any more.

THE COURT: You don't need to go into this. The court understands the situation.

MR. KREMER: I want to make it perfectly clear.

MR. GARRISON: I did not object.

MR. KREMER: I know you did not. I want the court to understand my position. We want to make it perfectly clear that the only reason in the world that Mr. Atwater was employed by the plaintiff, or the only reason Mr. Atwater had for assuming to accept employment from the plaintiff was the fact that he had previously been employed by the Butte & Superior and knew something about the facts of its operation.

MR. GARRISON: In the Miami case?

MR. KREMER: In the Miami case or any other case; any case.

THE COURT: I can't see that you need to go as far as that in order to make it clear that this wit-

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ness has worked for the company and has been required to testify to facts that he knew during that employment. The objection will be sustained, or the court itself will object to proceeding further along that line.

Defendant excepted.

X-Q. 80. Mr. Atwater, during the time that you were employed by the Butte & Superior you were the superintendent of the company, were you not?

A. I was general superintendent of the company.

X-Q. 81. Under a salary of $250.00 a month, were you not?

A. The salary was a little larger than that.

X-Q. 82. How much was it?

A. I believe I received $400.00 a month and my house rent.

X-Q. 83. When you quit?

A. When I quit, yes, sir.

X-Q. 84. What were you getting in 1911?

A. About three hundred—

MR. GARRISON: I object to that as irrelevant.

MR. KREMER: I think that with this character—that this character of testimony does require an explanation. I want to show the nature of his employment, that incident to the character of his employment he had no right to make contracts on behalf of this company for the conduct of litigation or otherwise, save and except the hiring of men in the mine or in the mill.

THE COURT: You may proceed with that. The objection to the last question will be sustained.

Defendant excepted.

X-Q. 85. Mr. Atwater you ran the mine, did you not? You were superintendent of the mine?

A. Yes, I was superintendent of the mine.

X-Q. 86. When did you become superintendent of the mine?

A. In October, 1909.

X-Q. 87. And you occupied that same position in 1911, did you?

A. In 1910 or '11, I don't recall which I was promoted from superintendent of the mine to general superintendent of the company.

X-Q. 88. As General Superintendent you had charge of the operation?

A. I did.

X-Q. 89. Of the mine and mill?

A. Yes.

X-Q. 90. You had a checking account covering the operations of the mine and mill?

A. Yes.

X-Q. 91. You had supervision over the books of account here locally?

A. Yes.

X-Q. 92. The books at that time were kept where—to refresh your memory weren't they kept in Duluth?

A. At that time the books were kept in Duluth.

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X-Q. 93. But you made entries here?

A. Yes.

X-Q. 94. Showing all of your expenditures?

A. Yes.

X-Q. 95. And you saw that they appeared on the books that were kept here?

A. Yes.

X-Q. 96. Do you recall keeping an account for James M. Hyde?

A. Yes, sir.

X-Q. 97. You entered that, or saw that it was entered under your direction on the books of the company, did you?

A. Yes.

X-Q. 98. That was your duty, was it not?

A. I did not enter it on the books of the company.

X-Q. 99. No, that you saw that it was entered, did you not?

A. Yes; for the payments made to him, I O. K'd.

X-Q. 100. Who was your bookkeeper at that time?

A. C. M. Everett was auditor of the company at that time in the Butte office, and before Everett came, I believe A. L. Swan was head bookkeeper.

X-Q. 101. You stated that you discussed with Mr. Hyde the question of a contract for the installation of a plant at Basin?

A. I said I discussed arrangements for the installation of a plant at Basin.

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X-Q. 102. When was that discussion had?

A. In June or July of 1911.

X-Q. 103. Was it reduced to writing, the results of your conversations and consultations with Mr. Hyde?

A. Yes.

X-Q. 104. By whom?

A. By yourself (Mr. Kremer).

X-Q. 105. I hand you a contract marked plaintiff's exhibit 1, and I ask you to examine the same and state to the court whether or not that does not embrace the full understanding that you had made or were authorized to make with Mr. Hyde.

A. I don't think it is necessary to read it all through. It is the contract.

MR. GARRISON: I would like to have the question read to the witness before he answers.

THE COURT: You can ask him yourself. He may acquaint himself with the contents so he can say if all the arrangements so far as he knew had between him and Hyde appeared in that contract.

MR. GARRISON: He is asked whether or not it contains the full terms. How can he tell unless he reads it all?

MR. KREMER: I am entitled to the writing as a matter of law; my objection was that the full contract was embodied in that written instrument.

THE COURT: Never between strangers.

MR. KREMER: The purpose is to show that

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he was the man that made it for the Butte & Superior Company.

X-Q. 106. Are you familiar enough with the contract to answer that question?

A. I think so, yes, sir.

X-Q. 107. State to the court whether or not that does not embrace the full understanding that you had made or were authorized to make with Mr. Hyde?

A. As I remember it, it does. I cannot commit this thing to memory while I am sitting here in the chair, unless I keep you here for a week, but as I remember it, this paper embodies all the points of our discussion, yes.

X-Q. 108. And all the payments that you made to Mr. Hyde were made under the terms of this contract, were they?

A. All the monthly payments that I made to him while he was working in Basin, yes, sir.

X-Q. 109. When you made the statement that you paid him a salary, using the word salary—

A. I did not make that statement.

X-Q. 110. Do you now say that you did not? I am not arguing with you, but I am willing to accept your statement. Did you pay him a salary?

A. I said that I paid him so much a month regularly.

X-Q. 111. Now, Mr. Atwater, I ask you the question; did you pay him a salary?

MR. GARRISON: Isn't that a matter of law, what that was called?

MR. KREMER: No, that is a matter of contract.

MR. GARRISON: I ask for a ruling on that.

THE COURT: He has stated what he paid him and how he paid it. I think the term you attach to it is rather a question of law, what it would be considered, unless you get the details of what it was paid for.

MR. KREMER: It is in evidence, and if your Honor will permit, I will read it so the question may be settled now as well as any other time.

"He was to receive no sum save and except his personal expenses while engaged in the mill work, such sum not to exceed $5.00 per day while installing the plant." Was that the contract?

A. That is what is written there?

X-Q. 112. Isn't that what you paid him?

A. No, we paid him regularly $150.00 a month for a thirty day month, on that basis.

X-Q. 113. Of his expenses at Basin?

A. Yes, that is the way we put it, to cover his living expenses at Basin we paid him so much, yes.

X-Q. 114. In accordance with the terms of this contract, or did you have any other authorization to pay him besides this contract?

A. No, I had no other authorization besides that contract. We paid him on that.

MR. KREMER: So we submit that the matter is clear.

MR. GARRISON: Isn't it already in evidence?

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MR. KREMER: I say that the matter is clear.

X-Q. 115. Mr. Atwater you stated that you had paid Mr. Hyde for his expenses of his trip to Duluth and New York. Do you recall when that payment was made?

A. No, I don't recall when either of those payments were made.

X-Q. 116. Did you make it in one payment or in two?

A. He would turn in his expense account when he returned from such a trip, and I would O. K. his expense account and he received his money from the auditor.

X-Q. 117. Do you recall in what year either of those sums were paid?

A. In 1911 he made a trip and I put my O. K. on his statement, as I said before.

X-Q. 118. Now where was that trip to?

A. I think that was to Chicago.

X-Q. 119. And then you told us that he made a trip to New York in 1912 I believe it was?

A. Yes, I think so.

X-Q. 120. Now then, the only sums, as I understand you—summing them up before passing—that you paid Mr. Hyde was his $5.00 a day under the contract in evidence, and his expense account for the trip to Chicago and his expense account for the trip to New York. Were there any other payments?

A. No, that is all the payments we made. There

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might have been other trips, which we may have paid; I don't recall; but there were just expenses of such trips and this monthly payment that I mentioned before.

X-Q. 121. You had charge of all the employes of the Butte & Superior Company, outside of the office, and the professional or legal department, did you not?

A. Yes.

X-Q. 122. Could you discharge or could you have, in your judgment, discharged Mr. Hyde?

A. Yes.

X-Q. 123. As an employe?

A. Yes, at that time I could have.

X-Q. 124. Upon what do you base that statement—the contract?

A. I based it on the fact that the president asked me why I did not discharge him—the president of the company.

X-Q. 125. Who was the president?

A. A. B. Wolvin.

X-Q. 126. That was where and when?

A. That was in Butte in 1912.

X-Q. 127. Was he working for you then?

A. Yes, he was there, supervising the construction of the flotation plant.

X-Q. 128. In your new mill?

A. Yes.

X-Q. 129. The Basin contract had ceased at that time, had it?

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MR. GARRISON: I object to that question.

Objection withdrawn.

X-Q. 130. Were you, at that time, operating at Basin?

A. Yes.

X-Q. 121. And was the flotation department operating then?

A. Yes.

X-Q. 132. Was Mr. Hyde operating it?

A. He was.

X-Q. 133. And was he staying at Basin?

A. He spent part of his time at Basin and part of his time in Butte. He was supervising the construction of the flotation plant in Butte, or was supposed to be supervising it, and he was also attending to this plant in Basin. He was also making trips away during those months; he was not here all the time, either in Basin or Butte.

X-Q. 134. When you say why you didn't discharge him, you mean why you didn't terminate the contract that is put in evidence here, do you not?

A. (Hesitating.)

X-Q. 135. Just answer that.

A. Well, the question was put to me by Mr. Wolvin; you asked me and I answered it. He did not say, terminate the contract; he asked me why I didn't get rid of him.

X-Q. 136. I will ask you to examine that contract and state if it does not provide that whenever the

superintendent of the Butte & Superior desires to do so, he can terminate the contract.

MR. GARRISON: I think whether that appears or not is a matter for the court and not the witness.

THE COURT: You may read it to him.

MR. KREMER: I did not want to take up the time. I thought he had it in mind.

THE COURT: If it appears there, say so, and base a question on it.

MR. KREMER: The question was based upon what does appear, if your Honor please; it is only a question of taking time to read it.

X-Q. 137. Was it not under the assumption that the Hyde process was not adaptable—was not profitable—that you considered terminating the contract?

MR. GARRISON: I object; there is no question whether he considered terminating the contract; he testified that the president asked him why he did not discharge or get rid of Hyde.

Objection sustained. Defendant excepted.

MR. KREMER: Well, on that basis it is only a question of—

THE WITNESS: I was—

MR. GARRISON: No, no.

MR. KREMER: If counsel is doing that for my benefit, he may cease. It is not necessary.

MR. GARRISON: I was doing it in the interest of propriety.

MR. KREMER: It is quite unnecessary.

THE COURT: Proceed.

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X-Q. 138. I will ask you if it was not in connection with the fact that the milling operation did not show the results that you had hoped, that the conversation took place that you referred to with reference to removing Mr. Hyde?

MR. GARRISON: I object. The witness did not testify to anything except that Mr. Wolvin said—

MR. KREMER: That is exactly the situation I refer to.

MR. GARRISON: And he has stated what Mr. Wolvin said and now he is asked whether that was not on an assumption in his mind or Mr. Wolvin's mind; and entirely improper question.

Objection sustained. Defendant excepted.

X-Q. 139. Did Captain Wolvin at that time state to you, and was not the substance of the conversation in connection with the incident to which you referred, that the milling operations under Hyde were not satisfactory, and that you should get rid of him?

A. My recollection of that conversation with Capt. Wolvin was that the trouble was not with the process; the trouble was with Hyde. We did not expect to break the contract. Capt. Wolvin advised me, or asked me why I did not get rid of Hyde.

X-Q. 140. You did not expect to break the contract—by that you mean to say that you intended to carry out the contract as it was written, is that correct?

A. Yes, that was correct.

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X-Q. 141. Now, Mr. Atwater, in connection with the matter of the keeping of vouchers. Do you know where the vouchers covering the period during which you issued checks to Mr. Hyde—where they were placed at the time that you left the employ of the company?

A. Well, at the start, anyhow, those vouchers were kept in the mine office—in the office at the mine.

X-Q. 142. Where were they at the time that you left, if you know—I ask so that we can make search for them.

A. I think likely those vouchers were still at the mine, but they might have been at the office down town. We had an office down town when I left the company.

X-Q. 142½. You could not be sure where they were?

A. Either one or the other.

X-Q. 143. I ask for the purpose of locating them.

A. One or the other.

X-Q. 144. Was there any other contract between the Butte & Superior Company and Mr. Hyde, to your knowledge, save and except the contract here in evidence—of course that is during the time you were connected with the company.

A. There was a modification of that agreement.

X-Q. 145. Was that made during the time that you were with the company?

A. Yes.

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X-Q. 146. I hand you this, plaintiff's Exhibit 2, and ask you if this is the paper.

A. Yes, this is the supplementary agreement.

X-Q. 147. Now, was there any other contract between the Butte & Superior Company and Hyde during the time that you were connected with the Butte & Superior Company, that you now recall?

MR. GARRISON: Unless that is confined to his knowledge, that is an improper question.

THE COURT: Certainly.

MR. KREMER: It could not be directed to anything else.

X-Q. 148. Of your own knowledge?

A. I don't recollect any other one at this time.

X-Q. 149. Now, Mr. Atwater, in your conversation with Mr. Hyde, the first one that you refer to, where did that occur?

A. My first conversation with Hyde?

X-Q. 150. Yes, the one that you testified to wherein he said that if you engaged in the concentration of ores as he directed that you probably would have trouble with the Minerals Separation, or something to that effect?

A. Up at the mine, the Black Rock Mine.

X-Q. 151. What year was that in?

A. 1911.

X-Q. 152. What month, do you recall?

A. Not exactly; it might have been May, but I think it was June or July.

Maxwell W. Atwater.

X-Q. 153. It was before the entering into this contract?

A. It was.

X-Q. 154. That is in evidence?

A. Yes. I said so.

X-Q. 155. And Captain Wolvin was doing the financial negotiations with Mr. Hyde, was he not?

A. Well, Captain Wolvin, the president of the company, O. K.'d the negotiations, but—

X-Q. 156. They could not be closed without his O. K., is that not the fact?

A. (Hesitating.)

X-Q. 157. Well, is it or is it not a fact?

A. Well, can't I stop and think while you ask me? I am trying to recall, that is all.

X-Q. 158. Certainly, if you wish to think.

A. Yes. There was never any contract—never any direct definition of how far my authority extended. As that contract looked to us then, it would have probably not been questioned if I had signed that contract instead of Captain Wolvin; but in the natural course of such operations it would have been up to the president of the company to ratify such a contract.

X-Q. 159. And that was the course pursued in the general conduct of affairs of the Butte & Superior Company, was it not?

A. Not in general, no.

X-Q. 160. Well was it, or was it not; I ask you the question you followed in matters of contract or

referring to unusual expenditures or expenditures outside of the ordinary conduct of the mines—were not those submitted to the president or the board of directors for ratification?

A. It was customary for me to submit it to the board of directors.

X-Q. 161. Now you said that there was no mention made of any particular patent in your discussion with Mr. Hyde. Did I understand you to make that statement?

A. This written contract—will you ask me that again?

X-Q. 162. I will connect it with something that I think will refresh your memory. You said that Mr. Hyde told you that he had a patent, for improvements upon certain then claimed patents. Is that correct?

THE COURT: He did not say that, I think.

MR. GARRISON: I object to that.

X-Q. 163. Certain issues of patent—

THE COURT: He testified that Hyde told him that he was going to get a patent.

X-Q. 164. He said he was going to take out certain patents, improvements on certain patents then in existence?

A. That is not what I said.

MR. GARRISON: Not at the first interview.

X-Q. 165. No, not at the first conversation, but the conversation wherein he told you that he was going to take out certain patents.

THE COURT: On the particulars wherein it differed from the Minerals Separation process.

MR. GARRISON: Yes, sir.

THE COURT: Proceed.

X-Q. 166. Where did that conversation occur?

A. In Hyde's laboratory in Butte.

X-Q. 167. Where was Hyde's laboratory in Butte?

A. It was either at the Napton or the Thornton; it was at the Napton Hotel or rooming house.

X-Q. 168. You stated that you asked him why he did not take out patents covering improvements upon the process, when he claimed that certain other patents were void; is that what you stated?

A. I did not use the word—

MR. GARRISON: He is misquoting the witness as to that; he did not say anything about improvements.

X-Q. 169. Well, I will ask you to repeat that conversation, then; what did he tell you that he was going to do?

A. He told me he was going to take out patents on particular parts of his process, which he considered patentable; one part, I think, on the use of acid, but I don't recollect. He told me—

X-Q. 170. One of recleaning?

A. Yes, I think so. I did not pay much attention to what his patents were to cover. I remember that he was going to take out patents.

X-Q. 171. Do you know whether he did take out a patent?

Maxwell W. Atwater.

MR. GARRISON: I object.

THE COURT: He can answer if he knows.

A. Yes, I knew that he took out a patent.

X-Q. 172. He told you that he had been advised by counsel that he had something that was patentable, and to take it out, did he?

A. Yes.

RE-DIRECT EXAMINATION.

BY MR. GARRISON:

R-Q. 173. Did he mention who the counsel were who had advised him?

A. Yes, sir.

R-Q. 174. Who did he say they were?

A. Mr. Sheridan.

R-Q. 175. In answer to a question upon cross examination, and after examining this contract, plaintiff's exhibit 1, which I now hand you, you stated that it represented the arrangement, the full arrangement that you had made with Hyde. Kindly point out to me the place therein which refers to the conducting or paying the expense of expected litigation.

MR. KREMER: That is objected to as improper re-direct and for the reason that there was no testimony with reference to the contract having been entered into between Hyde and the Butte & Superior for paying the expenses of prospective litigation. There is no contract of that character testified to.

THE COURT: I think so.

MR. KREMER: The witness said he had no authority except that that was given there. He was asked if a part of the agreement was not that the company stand what expenses of any suit brought against him. He said as far as he was concerned he would recommend that should be done, but there is no evidence that it was ever done, and the contract was drawn afterwards, and it was not done, and there is no testimony as to the authority. That is the reason I did not cross examine upon that.

THE COURT: Well, the question does not seem objectionable in that particular. If there is anything of that sort in there—You are familiar with the contract—point it out.

MR. GARRISON: It is not there.

THE COURT: If it is not there, so advise the witness and ask the question based on that.

R-Q. 176. You will observe, Mr. Atwater, that there is nothing whatever in that contract concerning the payment of expenses of litigation. You may take my word for that.

A. All right.

R-Q. 177. Based upon that, do you correct your answer, in which you stated that this contract contained the full recital of the things that you had agreed upon with Mr. Hyde?

MR. KREMER: We object to that for the reason that there is no testimony that the witness did agree upon it with Mr. Hyde or had authority to agree upon it with Mr. Hyde.

Maxwell W. Atwater.

THE COURT: There is testimony tending in that direction. I think the question fair under the circumstances. As the court has said, you can object later if it is not proven that there was an arrangement of that character, and the objection will be overruled.

(Question read.)

A. I will have to correct my statement in that matter.

R-Q. 178. Please correct it; please make the corrected statement.

A. I knew very well that such an agreement did exist and that we discussed it, and I thought it was in that agreement which you just handed me.

MR. GARRISON: That is all, sir.

RE-CROSS EXAMINATION,

BY MR. KREMER:

RX-Q. 179. Did you ever see a copy of that agreement?

THE COURT: What do you mean, exhibit 1?

MR. KREMER: No, the one he has just referred to.

MR. GARRISON: He said he thought it was in this one.

A. I said I thought it was in this one.

MR. KREMER: Now, I say did you ever see a copy of this agreement?

THE COURT: The one he has just referred to?

MR. GARRISON: This is the one he just referred to and he said he thought it was in that.

THE COURT: Make a proper objection.

MR. GARRISON: My objection is he did not say—

RX-Q. 180. MR. KREMER: Did you ever see a copy of that agreement about expenses?

A. No, I don't think I did. I thought it was in that agreement (Exhibit 1).

MR. KREMER: But you were mistaken, were you not?

A. I certainly was.

RX-Q. 181. And you are positive you never saw a copy of such an agreement?

A. I don't recollect seeing such an agreement.

MR. KREMER: That is all.

THE WITNESS: I don't recollect seeing such an agreement.

MR. KREMER: I heard what you said.

WITNESS EXCUSED.

MR. GARRISON: Now, I desire to offer in evidence the third annual report of the Butte & Superior Copper Company, Limited, for the year ended December 31st, 1914. As this is a very long document and there are a great many figures and pages of maps that are useless and there is only one paragraph that is useful, I desire to read that one in evidence.

MR. KREMER: We desire to know what he is offering.

MR. GARRISON: As soon as we read it you will know.

THE COURT: What is the offer, this whole report?

MR. GARRISON: If they insist. Otherwise, we would like to put in just the one paragraph.

MR. KREMER: We would like to know what it is.

MR. GARRISON: (Handing counsel the book and pointing out a marked paragraph).

MR. KREMER: No objection to it.

> Book ~~admitted,~~ marked for identification and following paragraph admitted and read in evidence and marked PLAINTIFF'S EXHIBIT 18.

MR. GARRISON: (Reading.) "The litigation in connection with the Minerals Separation Limited, which, at the date of the last annual report was pending and undecided on appeal, in the United States Circuit Court of Appeals at San Francisco, has since that time been decided in favor of your company by the Court of Appeals holding the patents of the Minerals Separation Company Limited as absolutely void. This question has been taken to the Supreme Court of the United States, where it is now pending, and a decision cannot reasonably be expected before some time in the spring or summer of 1916. Your directors have no reason to modify to any extent the expressions in the last annual report regarding the final outcome of this litigation. Respectfully submitted, N. Bruce MacKelvie."

Is it understood that this excerpt is all that now goes in evidence or simply the whole book received in evidence?

THE COURT: As far as the court understands it now you have offered only this paragraph.

MR. GARRISON: Is it conceded that the litigation there referred to is the case of Minerals Separation Company against James M. Hyde?

MR. KREMER: I am sure I do not know.

HENRY D. WILLIAMS called as a witness in behalf of the plaintiff, being first duly sworn, testified as follows:

DIRECT EXAMINATION,

BY MR. GARRISON:

Q. 1. Mr. Williams, you are the general attorney or counsel of the Minerals Separation ~~Company,~~ Limited, are you not?

A. I am.

Q. 2. In the year 1914 what litigation had that company pending which was decided by the United States Circuit Court of Appeals at San Francisco?

A. The suit of Minerals Separation Limited against Hyde, which was carried on appeal to that court from this court.

Q. 3. Had it any case pending at that time other than the Hyde case against the Butte & Superior Cop-

Henry D. Williams.

per Company Limited which was on appeal in the United States Circuit Court of Appeals at San Francisco and decided by that court?

A. No.

CROSS EXAMINATION,

BY MR. KREMER:

X-Q. 4. That is the same Hyde case that we have referred to here as having been decided by the Supreme Court of the United States?

A. Yes, sir.

X-Q. 5. And at that time the Hyde case was upon appeal from a judgment of the Circuit Court of Appeals declaring the patents invalid, was it not?

A. Not on appeal, ~~or~~ on writ of certiorari.

X-Q. 6. MR. KREMER: Writ of certiorari?

A. Yes, sir.

X-Q. 7. From a judgment declaring the patent invalid?

A. Declaring the patent in suit invalid.

X-Q. 8. And that was the patent in this suit as well as the patent in that suit?

A. Right.

X-Q. 9. Litigation was pending in this court was it not against the Butte & Superior Copper Company, Limited, upon the patent in suit?

A. It was then—That litigation was then pending.

WITNESS EXCUSED.

MR. GARRISON: Now, there is no dispute, is there, that Mr. N. Bruce McKelvie was the president of the Butte & Superior Copper Company, Limited, is there, in the year 1914?

MR. KREMER: No.

MR. GARRISON: Now, if your Honor pleases, we rest.

In view of something that your Honor said during the course of the hearing this morning, I was wondering whether your Honor intended to so shape the course of this trial that the defendant should first meet the issues with respect to the alleged estoppel or bar or whether there was to be a general defense, and I thought if proper I would like to receive from your Honor an expression as to the future conduct of the case in that respect.

THE COURT: Well, I haven't given it any thought, to tell the truth.

MR. GARRISON: What is the disposition of the defense?

MR. KREMER: The disposition of the defense would be to present its case in its own orderly way. The position that we take is that there is no estoppel or bar to meet, and the defendant shall proceed, after statement of counsel, of course with the consent of the court, to present its case in the orderly manner that it feels it should be presented in. We, of course, will be guided by our own desires in the matter, unless the court directs to the contrary. We naturally, like all attorneys, in arranging for the introduction of

the defense or the introduction of testimony, have outlined a plan whereby we believe that the orderly presentation will be such that one can readily follow it through and will lighten the work of the court; and that, of course, we will do unless the court directs otherwise. I do not know that we need any direction as to how we would introduce our case unless it is with the direction of this court; we will proceed in what we consider an orderly manner.

THE COURT: What is your view of it?

MR. GARRISON: My view is simply this: That if it be a fact that some principle of law estops these defendants from raising certain questions upon this trial, it would seem to me that the orderly course of procedure would be the demonstration of that situation. We have produced our evidence with respect thereto. If they present their evidence with respect thereto, that issue is entirely different and separate from every other issue in the case, and upon the determination of that issue will depend the orderly conduct of the rest of the case. At the present time if your Honor now enters upon the full defense of this defendant, you will be met at every turn with the necessity of letting in testimony with respect to the validity, we will assume, of this patent or the character of an act of an infringement of this patent, all of which will be immaterial and irrelevant, and never should have been brought into the case. If it be a fact that this defendant is by a principle of law estopped from raising that defense or relitigating that or those questions it does seem to me that it is well worthy of

consideration as to whether we may not lighten the burden of the court and counsel, litigants and witnesses by determining *in limine*—and the question in limine is "what is to be tried by me in this suit?" Now, if the issue is to be an entire, sole and complete defense, without bar or estoppel, that is one thing. If the issue is very much narrower than that, that is another. It does seem to me that the determination of that issue in advance would be of great benefit to the court.

MR. KREMER: I assume that under the rule that your honor has repeatedly declared in this case on the rulings upon the disclaimer as well as to our objections to other matters introduced, that a ruling upon all of these matters as they are introduced would be such a ruling as would permit the record to be made for a higher court, no matter what your honor's views might be as to them, but we of course will present our case in full and of course we assume that your honor would permit this method, no matter what your honor's views might ultimately be upon this or other questions, to go upon the record here for review by another court. And I will state that we have witnesses brought from a distance perhaps in connection with certain testimony that has here been introduced, that is to refute such testimony as has been introduced here as is capable of refutation. So we will proceed, under your honor's direction, with the orderly presentation of our case, and we submit to the direction of the court.

THE COURT: Of course it is obvious enough

that if this case could be determined upon the question of estoppel, that it would shorten it very materially. If it was obvious, as I said before, that the estoppel existed, why the court would not hesitate to so rule. But the first question that met the court would be right now whether you have proven an estoppel, in other words, a former adjudication that estops these defendants. It is true the court might send the defendant to their proof, if they desired to submit any. They might not desire to submit any. They might rely upon the insufficiency, from their viewpoint, of the proof of estoppel. I would want to hear it argued pretty thoroughly before I would be prepared to say that you have established an estoppel. There is evidence that tends in that direction, but whether it is sufficiently clear and definite enough sufficiently certain "to a common intent" as they put it,—you say you have witnesses that are not here?

MR. KREMER: That is what I meant by stating to your honor the other day that it was useless to take up the time of the court at present in arguing this matter.

THE COURT: What about your evidence in respect to that estoppel?

MR. KREMER: I have no doubt that Mr. Garrison's statement—

THE COURT: What I have in mind is, is your evidence here and available, if you intend to use it?

MR. KREMER: No, it is not. The question is whether we desire to use any or not use any. From this record as it is here submitted, we contend that

there is no estoppel shown. But if Mr. Hyde is available and I understand at this time that he is, a sharp issue will be then raised as to whether or not the statements here made are truthful. So we will proceed to make our statement, if your honor so desires.

THE COURT: Of course like in any other equity suit, if we proceed upon a record that might be fairly disputable and determine the question and let it go to the Circuit Court and possibly to the Supreme Court and comes back here for a new trial, I don't think it would be the best for either party or both parties. I imagine you are both anxious to have the record in such shape now that a final decision can be rendered in the upper court, in the appellate tribunal. I think it will make for a speedy conclusion of this case to allow the defendant to proceed at their discretion in the matter and the court will do so.

MR. GARRISON: I seek to reopen the closing of the case for the purpose of asking the defendant to produce from their New York or Duluth or other office the various vouchers and other matters which are not in Basin or Butte and which are called for in my notice to produce.

THE COURT: Well, it should be done during the course of the trial, if the trial continues long enough to enable them to do it. If they can do it I assume they can by correspondence. You were late with your notice to produce, but they will do that if the case continues that long and I assume that it likely will.

MR. GARRISON: We now close, with that reservation.

THE COURT: Let us first dispose of this proposed amendment to the answer. I find by examining it it proposes three publications not pleaded in the present answer if I remember right, two of which however are in evidence in the Hyde suit, the record of which is now in evidence here; and it also pleads perhaps some fifteen patents now in the present answer, one of which seems to be an Italian patent.

MR. SCOTT: The Italian patent corresponds to this British patent, and that is referred to in the Hyde case.

THE COURT: This amendment,—of course amendments are always allowed in furtherance of justice at any time where it can be done consistent with the rights of the other party. It, too, comes late, of course. And yet there might be in the condition of all this litigation an excuse. If the court can take judicial knowledge of it, unreasonable delay and neglect should not be charged against the defendant in proffering this amendment. The question would be of course whether the plaintiff is prepared to meet it. What about it? If it operated as a surprise, there is a serious question which ought to involve its rejection. If it does not, the state of the case is such, and of these documents and of the proof available to you, that you can meet it, the court desires to know it and if that is not the situation the court desires to know it. You have made an objection simply based on lack of diligence as I recall it and on the estoppel.

MR. WILLIAMS: On the estoppel, and not having then read the document, I find that there was an attempt to set up British application, which would be totally in violation of the statute, no application for a patent in England being of the slightest force and effect under the statute.

MR. KREMER: Well, just disregard that. Where does that appear? It can be eliminated by consent. We will eliminate it by consent.

MR. WILLIAMS: Lines 21, 22 and 23 of page 6.

THE COURT: Elmore British patent, 17816.

MR. WILLIAMS: The words on these lines, "F. E. Elmore obtained British patent No. 17816 of the year 1904 for the same invention and that said Elmore applied by said British patent August 16, 1904," the entire statement to be eliminated. The British patent in question was sealed long after our application date and the application has no force and effect.

MR. KREMER: We consent that it be eliminated —or I think more properly that we request that it be eliminated.

MR. WILLIAMS: Again on page 5, the same words, constituting lines 17, 18 and 19.

MR. KREMER: That may also be eliminated.

MR. WILLIAMS: Now, in regard to a number of patents that are set up, really not any patent at all, but applications for United States letters patent, appearing on the last page of the proposed amendment to the answer, I wish to note the general objection that the only force and effect that these, when proved, can have is upon the question of originality in the

identical invention of the patent in suit, and that that cannot in any manner be considered as part of the prior art. With that objection, now I see no reason why we should strike out the pleadings although as to the last patent in this list it appears that the date of application for United States letters patent was July 17th, 1906.

MR. KREMER: Strike it out if you want to.

THE COURT: What is that?

MR. WILLIAMS: F. E. Elmore, 826411.

THE COURT: What was the date of the patent?

MR. WILLIAMS: The date of application is July, 1905. The date of our invention is March, 1905.

MR. KREMER: Strike it out.

MR. WILLIAMS: And again on page 5 at line 16 the same patent, 826411.

MR. KREMER: That is the same.

THE COURT: That goes out?

MR. KREMER: Yes.

MR. WILLIAMS: Now, as to the California journal of technology, we do not plead surprise. We litigated a case in Wilmington, Delaware, wherein that was one of the defenses. We know of the existence of such a document. I don't know that we have come here prepared to meet it, but I believe we may be able to do so. The ground of our objection to that is that it is a new defense and the ground of objection is estoppel.

MR. KREMER: Is that all, Mr. Williams?

MR. WILLIAMS: That is all.

THE COURT: The objections will be overruled,

as to the amendment to the answer, and the amendment will be filed.

MR. KREMER: In conformity to the rule of court, I desire to submit an engrossed copy of the answer as made. That is the rule for the purpose of convenience. And I will ask permission to file this as soon as the amendments are made and it conforms to the matters stricken out by the court. That will be agreeable, and I will furnish you with a copy.

MR. GARRISON: Perfectly.

WHEREUPON the defendant made an opening statement to the court as follows:

MR. SCOTT: This patent No. 835,120, your honor, here in suit has been sustained by the Supreme Court of the United States principally, if not wholly, upon the theory that there was what the court has referred to as a critical point. That has been the theory of all of the witnesses produced by this plaintiff from the beginning of this case; it has been almost the sole reliance,—the principal reliance of plaintiff's counsel in all of their argument and presentations of this case. It was the theory upon which the Supreme Court of the United States has sustained this patent. And yesterday morning was the first instance in which we had seen this wonderful critical point repudiated by counsel for the plaintiff. While the Supreme Court was prevailed upon to accept this remarkable theory of a critical point in the matter of the amount of oil in this flotation process, we are compelled, in view of the character of the evidence and the character of the arguments made by counsel before the Supreme Court, to come here

attacking the validity of this patent upon the theory that there is no critical point. So confident are we that the Supreme Court of the United States was misled by garbled evidence and arguments that misrepresented even that evidence, that we come here for the purpose of trying that issue of the validity of that patent once more. Now, there can be no question from the text of the opinion of the Supreme Court that the supposed existence of this critical point, so much emphasized by the witnesses for the plaintiff, and by the counsel for the plaintiff, was the foundation of the opinion by the Supreme Court. The fact that the Supreme Court declared claims 9, 10 and 11 invalid—the only three claims that did not specify this small amount of oil—is in itself convincing and conclusive proof that that was the foundation of their opinion. One of the closing expressions of the Supreme Court and one the meaning of which was invalidated in this disclaimer by having the passage taken from its proper context and put in another setting, is this: "The results obtained by the use of oil within the proportions often described in the testimony and in the claims as critical proportions, amounting to a fraction of one per cent on the ore."

Now, a "critical point," by every definition, popular, scientific or otherwise, is some point either in a physical change or in a mathematical conception where there is a transition, where one phenomenon changes to another. On this question the proposition has been advanced that when a certain point is reached in the reduction of oil we have the transition from a floating mass of mineral to a sinking mass, providing such quan-

tity is being raised, or if we follow the procedure dwelt upon so fondly by the witnesses for the plaintiff, the sinking is changed to flotation by reducing the amount of oil.

Referring again to this disclaimer, not that I am going to discuss that, but to illustrate and make clear the line of evidence which we are going to introduce. The gist of the disclaimer is contained in one expression: "He hereby disclaims from claims 9, 10 and 11 of said letters patent No. 835,120 any process of concentrating powdered ores excepting where the results obtained are the results obtained by the use of oil in a quantity amounting to a fraction of one per cent on the ore." Now, it takes close attention from me to follow the refined argument upon which counsel for the plaintiff here baldly tells the court that they are not disclaiming anything but they are enlarging their patent by this disclaimer. The proposition advanced is that they are entitled to the results obtained by the use of less than one per cent of oil, the implication being that if these results are obtained by the use of more than one per cent of oil they are still entitled to them. I think that is a fair statement of the idea that was put forth by them before this court. Now, that statement is absolutely inconsistent with any theory advanced by any one of the expert witnesses who have appeared for this plaintiff throughout this litigation. It is opposed to the decision of the Supreme Court and it is absolutely opposed to the representations made to the Supreme Court by counsel here present in their arguments which resulted in their patent being sustained. The very definition of the term "critical point" absolutely removes

the possibility of this patent being valid and the owners of the patent still being entitled to something which is done by the use of an amount of oil larger than the "critical amount." The whole foundation of this patent, the very words of their own witness, Dr. Chandler, is based upon this amount of oil, the critical amount. So we will assume that there is a critical amount here; and in a day or two we will prove to the court that there is not. But, as far as that—as this case—has gone, we will say that there is a "critical point." This phenomenon does not come into play, there is no froth until the oil is below that "critical amount." That is the whole theory and foundation of the decree of the Supreme Court as to the supposed validity of this patent. And if that proposition isn't true, that patent isn't valid, and every court that this case has been presented to by plaintiff has been deceived.

THE COURT: What will you do in connection with this Supreme Court's decision?

MR. SCOTT: I will explain that, how that comes about?

THE COURT: No, what shall we do?

MR. SCOTT: We will present evidence here that was not before the Supreme Court, evidence which we conceive would have left no doubt in the mind of the Supreme Court as to the absolute invalidity of this patent. We will present evidence in this court that counsel for the plaintiff assured the Supreme Court in the most emphatic terms could not be produced. Counsel for this plaintiff assured the Supreme Court, and we did not have the evidence to meet it because this

case was tried at so early a date, they assured the Supreme Court that any operation with over one per cent of oil was an impossibility, commercially, that it could not be done. They told the Supreme Court baldly that we, for the defendant, were there presenting tricks, shams, ledgerdemain; that we had done things in little machines on a bench that no man could duplicate in a mill, by which no man could concentrate ores and succeed; no one had concentrated ores in a mill with that large quantity of oil. And the evidence in the Hyde case was taken and the assumptions of these witnesses were accepted. And since these assumptions were made millions of tons of ore have been concentrated in the great mills of the United States with over one per cent of oil and in many instances showing even a greater efficiency, metallurgically, than previous operations with small amounts of oil. And we are convinced that it was assumptions of that character that led to the decision of the Supreme Court. And we conceive that we do not come here in vain to try this case with a view to having it ultimately reach the Supreme Court; and we do not conceive that the Supreme Court, with evidence of that kind before it refuting the solemn assertions made by these counsel who are here and who were there, will ever adhere to the decision then made.

So inconsistent is the position of this plaintiff in this court with its position in the Supreme Court of the United States that they do not hesitate to absolutely deny and repudiate what they told the Supreme Court in attempting to sustain their patent when they come here with the fear in their hearts that somebody has

made a successful process with over one per cent of oil. They told the Supreme Court, counsel here present, that their invention did not come into existence until you had below one half of one per cent. In answer to questions put by the court, by Mr. Justice McReynolds, where this invention came into being, counsel here present, in response to the question: "Do you have any invention at half of a per cent?" And counsel said, "It begins to appear remotely, but it begins to appear; at three tenths of one per cent it increases, and at two tenths this great inventive child was fully delivered. And they come into this court repudiating this assertion. And so if somebody said this thing would appear at one per cent they could come in and say, "They infringe our patent," after having told the Supreme Court in precise terms that their patent could not be infringed if the operator used over one-half per cent, they were so afraid they were going to fail to put over their proposition that they even desired this one per cent amended in the patent and consequently said, "Give us one-half per cent and we are satisfied." Now, they come back here and want more than one per cent in a disclaimer which enlarges their patent.

But at the risk of repetition, I want to put one proposition again that I think I briefly stated. We have litigated here based upon the evidence of experts, based upon the arguments of counsel to the effect that there was a "critical point." Now, I think we should have in our minds a sharp definition of a "critical point." I think I may say that 32 degrees Fahrenheit is a "critical point." It is where water freezes. Now it freezes

right at 32 or it wouldn't be a "critical point," if there was any variation about it. Pure water will freeze at 32 degrees Fahrenheit. Now, the Supreme Court mentioned this critical point. The Supreme Court did not say where it was, but they thought that a claim that merely called for a certain amount of oil was altogether too indefinite. That was like saying that water froze somewhere, some point; but they allowed this claim to be considered valid which called for a fraction of one per cent of oil; but the Supreme Court of the United States did not say that even one per cent was the "critical point." They avoided that. They said there was a critical point and in order to find out where that "critical point" was we look to the remarks of counsel, and they say somewhere at one half per cent, or below. But the proposition is it must be somewhere. And having put it there, to claim that anything infringes their patent above that "critical point" is to say there is no "critical point," because if there is a "critical point" that is passed—that is placed where one phenomenon changes into another and if you can get that same result with a larger amount of oil then there is no critical point. The very definition of a "critical point" is this deciding at what particular point, with relation to the amount of oil, you come to a point—a line where the phenomenon changes. Now, when they say that if anybody gets this result with more than that amount of oil, they are admitting that there is no "critical point," that there is no point where the phenomenon changes.

Now, as to the proposition as to whether there is a "critical point" or not we shall produce evidence show-

ing the absolute identity of these methods, identity in appearance, identity in metallurgical value and identity in the scientific and analytical explanation of their existence. We will show that in series such that no man can point out a critical line of demarcation between one phenomenon and another. Furthermore, we will show to the court that this Cattermole phenomena which I think perhaps the court remembers from the proceedings in the case some years ago, in which the mineral was caused to be sunk by a large amount of oil, the theory of this patent being that when you lessen the amount of oil that causes the metal to float instead of sink, as in this Cattermole process. We will take exactly the same mixture and will agitate it and cause it to float, and, without changing the mixture one iota we will cause it to sink, showing that oil has nothing to do with it. The whole theory of this case is a matter of manipulation, that it is merely a matter of how the thing is stirred up as to whether it sinks or floats. Not only that, but we will show the court, not only in experimental apparatus, but through the evidence of witnesses, we will show this court that commercial froths of greater metallurgical value are produced with larger amounts of oil, not only as great as this Cattermole process, but even greater.

The attempt made here to enlarge this patent by disclaimer, if one may use such a paradoxical expression, and it is the only correct expression, is emphasized throughout this record which is already before this court as a part of this case by stipulation, the Hyde case, and I refer to this because it will emphasize, I

hope, in the mind of the court, the force of the evidence which we are going to produce. Their expert witness, Dr. Chandler, started out with the proposition that the reduction of this quantity of oil was the foundation of this invention. Now, when we show the same phenomenon with amounts 10, 20, 40 times as great as the highest item with which they themselves have put forth in their definition of the invention, how can we believe there is any invention here? The thing is inconceivable. They had their chance as to how to define this invention. There was their patent. They put the facts and the evidence around it, and we go outside of these matters and find the same thing in the prior art. Dr. Leipmann has referred to the amount of the oil as "infinitesimal" and as "microscopic" and yet we have the plaintiff here in this very suit validating its patent so that it has a right in court by filing a disclaimer; which according to their confessed intention is not to comply with the Supreme Court and narrow their patent, but which, according to their statement made in court, is for the purpose of enlarging it beyond the thought even of the patent solicitor who drew it years ago or beyond the fond vision of the inventor. They now desire to include operations such as are today being carried on at the Butte & Superior Mining Company with amounts of oil greater than one per cent. The patent itself defines the amount as less than 1%. The Supreme Court has handed down an opinion, a decree based upon the very idea that the patent is confined to one per cent, and has declared three claims invalid upon that theory, and they come into this court to

maintain their standing in court, as they must, by filing a disclaimer, by which disclaimer instead of containing the patent within its proper bounds, by the very admission and claims of counsel, is intending not to comply with but to deceive the Supreme Court. The Supreme Court has said your patent is restricted, and they say now, "Your honor, you meant to widen it despite your express statement to the contrary. Dr. Liepmann has said there was no froth over one per cent. With years of study this patentee, with all of these experts, say there is no froth over one per cent. And yet, if we make a froth with over one per cent they say "we invented that ten years ago."

A great deal is being made in this case by the plaintiff of the decree of the Supreme Court. I think I am entitled to show this court what kind of representations that decree was founded on. These are the representations made in arguing to the Supreme Court of the United States.

THE COURT: I dont' think we should go into that.

MR. SCOTT: Must we accept the decree without the admissions that were solemnly made in court as the basis of that decree?

THE COURT: I think that decree is binding upon the same set of facts anywhere.

MR. SCOTT: But, for the meaning of the decree. The decree—there is no question as to the decree being binding upon the same state of facts. We are not going to present the same state of facts.

THE COURT: I understand.

MR. SCOTT: We will present a different state of

facts and presenting that different state of facts, we think we should be allowed to show the record upon which—

THE COURT: If it should be when offering it then we will take it up and discuss it. I do not think it comes in the way of an opening statement by counsel.

MR. SCOTT: There is one point more that I wish to make in connection with the alleged disclaimer. There are two ways—I will take the liberty of explaining, although it may be familiar to the court—of changing a patent after it is issued. One is by a disclaimer, with which the court has become quite familiar in the last two days. The disclaimer is simply a way of amputating something from the patent, cutting something out of it; and the other way is by reissue. If the patentee through inadvertence, accident or mistake has claimed more than he is entitled to or has made some error, he is allowed to surrender his patent to the Commissioner of Patents and to apply for a reissue. Now, having done so, the Patent Office examines the patent over again in its entirety. They can take away from him that which he had in his first patent if they want to. And in case the patent is reissued there are no rights antedating the date of the reissue. Everything in the past is wiped out. He can collect nothing for damages for infringement prior to the granting of the reissue; and the reissue expires on the same date that the original patent would have expired on. Furthermore, we will assume that the patentee has not claimed his invention as broadly as he was entitled to and wants to reissue it in order to broaden his claim to in-

clude something that it would not have included in its original form. Now, if it so happens that before he applies for his reissue some third party, some member of the public actually manufactures this article or practices this process which he wants to include by broadening his claim, he is not permitted to do so unless he has filed his application before that member of the public does manufacture that article, or practices that process. If he does not apply for his reissue until after some member of the public has manufactured the article or carried out the process which he wishes to include, he is precluded from getting a reissue by what is termed "the intervening rights" of this member of the public. Now, in this matter of disclaimer the patentee meets no such obstacle. The very theory of the disclaimer is that he is giving something back to the public; therefore, there can be no intervening rights. At most he is giving the public something, and there is no possibility of the patentee taking more from the public than his original patent took. He is giving them some of his monopoly. In the second place, the procedure by disclaimer avoids a re-examination of the patent by the patent office. The patentee simply draws up this paper and files it in the patent office; no one looks at it, his patent is not examined because the theory of the thing is he is giving something up and he can be trusted to do that. Now, in this particular case here before the court, assume that the patent in this particular was not as broad as they wanted it to be, and that is what they have said already, that it was not; they want more than one per cent now. Their proper procedure would have been to apply for a re-

issue of their patent if they wanted to broaden it. It is the only procedure by which one can properly broaden a patent. But why was it objectionable to them to proceed by application for reissue? First, that at the time they filed their disclaimer thousands of tons of ore were being treated by the flotation process every day with over one per cent of oil. The intervening rights would have prevented any possibility of their getting a reissue. Second, the great lapse of time since they took their patent out, over ten years ago, would have been sufficient to prevent it. And, third, had they applied for a reissue the probability is that the patent office would have taken their whole patent away from them because the evidence which we shall present to this court will show that there was—we shall present to this court will show plainly that there is no boundary to this "critical point," and immediately you go beyond the one per cent and the "critical point," we arrive in the realm of the prior art.

Now, if there is still time this afternoon I propose to examine at least one witness.

MR. KREMER: We might save time by proceeding with some matters. Perhaps we can take up—

THE COURT: Proceed at your discretion.

MR. KREMER: We will ask Mr. Ballot to be sworn.

John Ballot.

JOHN BALLOT, called as a witness in behalf of the defendant, being first duly sworn, testified as follows:

DIRECT EXAMINATION.

BY MR. KREMER:

Q. 1. What, if any, position do you hold with Minerals Separation, Limited?

A. Chairman.

Q. 2. Chairman of the board of directors?

A. Yes.

Q. 3. What, if any, official position do you hold with a corporation known as Minerals Separation North American Corporation.

A. President.

Q. 4. What, if any, interest has Minerals Separation Northern American Corporation in the patent in suit?

A. They acquired the interests of the patent—

MR. GARRISON: That is expressed by writing which we will produce if they wish it.

MR. KREMER: It is immaterial to me how it is proven.

MR. GARRISON: We will produce all of the matters which have to do with the North American Corporation and Minerals Separation, Limited.

THE COURT: Is that satisfactory?

MR. WILLIAMS: They are not in my possession now, they will be in my possession this evening.

MR. GARRISON: We sent for them to New York.

MR. WILLIAMS: They are coming from New York. It takes three days.

John Ballot.

MR. KREMER: I think this question is proper.

THE COURT: He may answer.

Q. 5. What if any interest has Minerals Separation North American Corporation, in the patent in suit?

A. They acquired the interest of the patent.

Q. 6. What else?

A. They own the interest in the patent.

Q. 7. They own the interest in suit?

A. They do not own it in this sense, that it has been transferred to them, but they have acquired the rights to the patent.

Q. 8. The American rights to the patent?

A. The American rights.

Q. 9. Then, as I understand you, Minerals Separation North American Corporation, own the American rights to patent No. 835,120, the patent in suit?

A. They do.

Q. 10. When did they acquire the American rights?

A. December 7th of last year.

Q. 11. December 7th, 1916?

A. But no transfer has taken place of the patent. The parent company retains it as a trustee for the American corporation until this litigation is finished.

Q. 12. Minerals Separation Limited, then, is only the trustee?

A. The registered owner.

Q. 13. For Minerals Separation North American Corporation?

A. And registered owner.

Q. 14. But in fact Minerals Separation Limited own

John Ballot.

no American rights; Minerals Separation North American Corporation, owns those rights?

A. The beneficial rights.

Q. 15. Under the laws of what state is Minerals Separation North American Corporation, incorporated?

A. Maryland.

Q. 16. To refresh your memory, is it not a fact that all of the stock of Minerals Separation North American Corporation was issued in payment for the American rights to certain patents including the patent in suit, 835,120?

A. That is so.

Q. 17. That is the fact?

A. Yes.

Q. 18. And that issue of the stock was made when?

A. December 7th, 1916.

Q. 19. I present to you a copy of the Mining and Engineering World, of date December 30th, 1916, and turn to page 12 of that journal, and I ask you to state if, as president of Minerals Separation North American Corporation, you recognize that advertisement?

MR. GARRISON: I don't understand exactly the question, but I don't think it is worth while to object. If he means that they are responsible for the advertisement, that is another thing.

MR. KREMER: I can not ask that until he looks at it. He might say he never saw it before in his life.

MR. GARRISON: You can ask him the direct question.

Q. 20. (Last question read.) Q. Do you recognize that advertisement as one that you had ordered inserted in that journal?

MR. GARRISON: With that addition I have no objection.

A. Yes, we are responsible for it.

MR. KREMER: We offer in evidence page 12 of the Mining and Engineering World, of date December 30th, 1916.

MR. GARRISON: That is objected to as incompetent and irrelevant to any issue in this suit.

THE COURT: What is the object, Mr. Kremer?

MR. KREMER: It is in connection with our argument that the disclaimer—and is evidence of unreasonable delay, in this: under the question of law presented to the court and argued solely as a question of law, there was considered only the question of unreasonable delay per se. There was no evidence showing the attitude of the holder of the patent at that time insofar as the public is concerned, in holding itself out as the owner of a valid patent. We offer this testimony, and I will offer other testimony of this character, for the purpose of showing that, under the circumstances of this case the delay of over 100 days, or 74 days, if you so choose to interpret it, was an unreasonable delay under the conditions, because the whole industry of mining in this country was laboring under the belief of the truthfulness of the representation that the owner of the patent was making throughout the length and

John Ballot.

breadth of the land—under the belief in that truthfulness—and if we can establish this fact, that these representations were being made, then there is positive evidence of the reason of their delay, and there is positive evidence of the fact that they were profiting by their unreasonable delay, and were practicing deception upon the public. What might be reasonable delay under one state of facts, becomes a most unreasonable delay under another state of facts, and this is a part of the chain of evidence, showing why this delay was unreasonable. Their patent was absolutely void through this whole period, because there had been no disclaimer filed, and that statement is borne out by the admissions here. It could only be cured by the filing of a disclaimer without unreasonable neglect and delay. Now, that is the purpose of this testimony, that is, the testimony of these advertisements. Of course it must immediately become apparent to your honor that the question with reference to Minerals Separation North American Corporation, presents still another question, which is not concerned.

MR. WILLIAMS: I might give you notice now, Mr. Kremer, that if we can prepare this evening, a supplemental bill of complaint, bringing in Minerals Separation North American Corporation, as a party plaintiff, upon the arrival of the train this evening, we will present such a bill tomorrow, but it may not be physically possible to do it.

MR. KREMER: Of course the evils of the day are sufficient.

MR. WILLIAMS: I will read the advertisement: "The flotation process. All rights under this process in North America are now controlled by Minerals Separation North American Corporation. The Supreme Court of the United States having established the validity of the basic patent, for froth flotation, notice is given that the company is ready to grant licenses for the use of this process to those who wish to install and use it. To those who have infringed the patent, notice is given that a settlement for past infringement must precede the granting of license for the future use of the process. Notice is also given that the company will enforce its patents, and will stop all infringement." Then follows a statement about maintaining a laboratory where ores will be tested at minimum expense for prospective licensees. That is the substance of the advertisement.

THE COURT: Well, under the rule and promise of counsel that he has other evidence which, taken altogether, he believes will establish unreasonable neglect and delay, the objection will be overruled and the advertisement may go in. If it is not entitled to any weight when the court comes to render its decision, it will be given none.

Plaintiff excepted.

Advertisement contained in Mining and Engineering World, December 30th, page 12, is admitted in evidence marked defendant's exhibit No. 19.

MR. KREMER: I will offer another.

John Ballot.

MR. GARRISON: We will present that to Mr. Ballot, and if he says he authorized that, we will admit it.

BY MR. GARRISON:

Q. 21. Was this authorized by you or your company?

A. Yes, sir.

MR. KREMER: This is in the Engineering and Mining Journal of date December 23rd, 1916, page 35. It is—

MR. GARRISON: It is admitted by counsel for the plaintiff that this advertisement was inserted by authority of Minerals Separation North American Corporation.

MR. KREMER: We offer it in evidence.

MR. GARRISON: We make the same objection.

Objection overruled; plaintiff excepted.

Copy of Engineering & Mining Journal, of date December 23d, 1916, page 35, marked Defendant's Exhibit No. 20 and admitted in evidence.

MR. KREMER: I offer in evidence a similar advertisement included in the Salt Lake Mining Review, of date January 15th, 1917, page 55 of that paper.

MR. GARRISON: We make the same objection.

Objection overruled; plaintiff excepted.

Page 55 of the Salt Lake Mining Review, of date January 15th, 1917, marked defendant's exhibit No. 21 and admitted in evidence.

MR. KREMER: I offer in evidence a similar advertisement appearing in the Mining & Scientific Press, of date January 6th, 1917, being upon page 15.

MR. GARRISON: The same objection.

Objection overruled; plaintiff excepted.

> Page 15 of the Mining & Scientific Press of January 6, 1917, marked Defendant's Exhibit No. 22 and admitted in evidence.

Q. 22. Mr. Ballot, approximately in how many journals, mining and engineering journals, did you cause that publication to be made?

A. Well, I cannot tell you that from memory.

Q. 23. Were there a great number or only a few?

A. Maybe six and maybe more, I would not say.

Q. 24. Over what period of time did that advertisement run?

A. I could not say.

Q. 25. Approximately.

A. Probably a month or two.

Q. 26. During the months of December, January and February, would you say?

A. I can not answer exactly; probably December and January—maybe two months, and extending into the following month.

Q. 27. Did you run it into February?

A. Very possibly.

Q. 28. Did you cause the publication to be run in any financial papers?

John Ballot.

A. It depends on what you call financial papers. If you name the papers to me, possibly I could remember.

Q. 29. For instance, the Boston News Bureau?

A. Yes, I think so.

Q. 30. Did you cause that to be run during the month of February, 1917?

A. Yes, and probably longer.

Q. 31. I present you with a copy of the Boston News Bureau, of date February 21st, 1917, on page 10, and I will ask you if you caused that advertisement to be inserted.

A. I think so, yes, sir.

MR. WILLIAMS: We will admit that we did. It is the same advertisement.

MR. KREMER: We offer in evidence the advertisement appearing on page 10 of the Boston News Bureau of date February 21st, 1917.

MR. WILLIAMS: The same objection, your honor.

Objection overruled; plaintiff excepted.

> Boston News Bureau, of date February 21st, 1917, page 10, marked Defendant's Exhibit No. 23 and admitted in evidence.

Q32 Did you cause an advertisement to be run in the New York Commercial—I hand you one dated December 15th, 1917.

A. Yes, sir.

MR. WILLIAMS: We will admit that the company authorized the publication of this reading notice

in the New York Commercial, which is in fact and in substance, an advertisement.

MR. KREMER: We offer in evidence page 14 of the New York Commercial, of date January 15th, 1917.

MR. WILLIAMS: The same objection by the plaintiff:

Objection overruled; plaintiff excepted.

> Page 14 of New York Commercial of January 15th, 1917, marked Defendant's Exhibit No. 24, and admitted in evidence.

MR. KREMER: I don't like to offer a letter of counsel. Will you admit that copies of this letter were sent to various people at the instance of the plaintiff?

MR. WILLIAMS: Yes, certainly. I did this as counsel for Minerals Separation, Limited, and Minerals Separation North American Corporation.

MR. KREMER: I offer in evidence a letter written by Henry D. Williams, dated January 30th, 1917, under the statement just made by Mr. Williams that he did it as counsel and at the instance of Minerals Separation, Limited, and Minerals Separation North American Corporation—

MR. WILLIAMS: That is right.

MR. KREMER: And that this letter was sent as a notice of infringement and claim of right. Is that correct?

MR. WILLIAMS: Yes. But I object to it on the ground that it is incompetent, irrelevant and immaterial as to any issue in this case.

Objection overruled. Plaintiff excepted.

MR. KREMER: Attached to the letter was a copy of the opinion of the Supreme Court, and the other documents described in the letter. We offer those also.

MR. WILLIAMS: The same objection.

THE COURT: Objection overruled.

Plaintiff excepted.

> Letter of Mr. Williams dated January 10th, 1917, admitted in evidence and marked DEFENDANT'S EXHIBIT 25.

MR. KREMER: For the sake of brevity, will you not agree that similar letters and similar statements with similar enclosures were sent to a great number of mine and mill operators in the United States during the months of January, February, March and April, 1917?

MR. WILLIAMS: That is rather indefinite. If you will omit the word "great" I will accept it.

MR. KREMER: Will you substitute the number, Mr. Williams; I will call on you for that information, and your statements, off the stand, is all that we desire.

MR. WILLIAMS: I would say that, having learned that there were something in the neighborhood of 200 mines infringing the patent, we sent these notices to those mines. I think possibly the number exceeded 200, but that is the best of my knowledge and I will stipulate in the neighborhood of 200.

MR. KREMER: During the months that you mentioned, January, February and March, we will say?

MR. WILLIAMS: Yes, but not April.

MR. KREMER: Yes, I have got one in April.

MR. WILLIAMS: Have you? I see. And April, yes.

MR. KREMER: I think that covers that feature of the matter.

THE COURT: Very well, proceed.

MR. KREMER: I have engrossed the answer, under the rules, that where the amendment is offered it should be inserted in the original answer. I present a copy to counsel for the plaintiff. The document presented is the answer with the amendment included. Of course it does not include the supplemental answer, which I take to be a separate document, and did not engross it with the other. However, I have here a copy of that answer, and I offer this at this time, and ask that it be filed. Of course if counsel finds any error in it—

MR. WILLIAMS: Subject to correction it may be filed.

MR. KREMER: That may apply to both of us. Subject to correction for error, of course.

MR. WILLIAMS: Yes.

THE COURT: It may be filed.

FRANK R. WICKS, called as a witness in behalf of the defendant, being first duly sworn, testified as follows:

DIRECT EXAMINATION.

BY MR. SCOTT:

Q. 1. State your full name, please?

A. Frank R. Wicks.

Frank R. Wicks.

Q. 2. What position do you hold at present?

A. I am at present assistant superintendent of mills for the Chino Copper Company.

Q. 3. Located where?

A. At Hurley, New Mexico.

Q. 4. What experience have you had in a general way in the duties of the kind you now perform?

A. I have been associated with milling and metallurgical companies for about twelve years.

Q. 5. And in a general way your duties are of what character?

A. During the first two years my duties were entirely clerical and mechanical. During the next five years they were both mechanical and metallurgical, because our organizations at that time were not very extensive. In the next three years I had supervision over mill operation, embracing all the departments of milling, and the same is true, though with a different company, in the last two years, which makes up the whole twelve years.

Q. 6. Have they a flotation plant in the mill where you are now engaged?

A. Yes, sir.

Q. 7. Are you familiar with the operation of that flotation plant?

A. Yes, sir.

Q. 8. Have you operated or had that plant operated under different conditions as to quantities of oil or other reagent ordinarily termed oil?

A. Under a number of different conditions.

Q. 9. How do the results compare, with different quantities of oil?

MR. WILLIAMS: I object, your honor, to this testimony, first for the reason that having proved that an estoppel exists, that this defendant has had its day in court; that no evidence tending to show what can be done in the flotation operation, other than that of the defendant, and other than those that are within the issues in this case, is of any relevancy whatsoever. I make that the first objection.

Further, the Supreme Court of the United States having decided that our patent is a valid patent for a patentable invention, any attempt whatever to alter or attack the facts found by the Supreme Court, under the doctrine of *stare decisis,* is irrelevant and immaterial. The decision of the Supreme Court of the United States applies to the fact that we have proved, establishing the infringement, because we have proved that this defendant has done just what Hyde did; and that this defendant did that before the commencement of this suit and after the issuance of our patent; therefore the facts in this case are the facts of the Hyde case, and upon those facts the Supreme Court of the United States has held that the patent is valid and infringed, and any testimony attacking the validity or the patentability of the novelty of the invention is an attempt to alter the state of the law as to the state of the facts which is before this court. The Supreme Court has held that under the state of the art the in-

vention was patentable, and the Supreme Court of the United States and the general law—the general patent law—is not concerned with things that have happened since the invention. Of what possible force and effect can the operations of the Chino Copper Company be in determining novelty? Because they are not of a prior art at all; they are within the last few months or years. We are dealing here with an invention that was made in 1905.

The third ground is that this is not evidence of anything that has the slightest bearing upon the novelty of the invention, the Supreme Court having decided as to the novelty and patentability of the invention.

MR. SCOTT: I think I have explained our position very fully in my opening, that the testimony which the witness is about to give is directed to the simple issue as to whether this patent affirms the truth in stating that a new phenomenon occurs and a new invention has been made when the quantity of oil is decreased below a certain amount, and I will perhaps elicit from the witness the truth regarding the effect of doing these things and doing them upon a milling scale. His testimony in that aspect would be similar to that of an expert who came in with the result of a laboratory experiment. The fact that his testimony will concern the operations in a mill, only renders it more relevant.

As to the Supreme Court having decided that this patent is valid upon the prior art, the Supreme Court did decide this case upon the prior art that was before the court; but there will be additional prior arts before this court and additional evidence before this court.

MR. WILLIAMS: There is not yet.

MR. SCOTT: The evidence is now being given.

MR. GARRISON: I only want to emphasize one point. It seems to me very clear that, the Supreme Court having decided, beyond the possibility of any doubt, that in the then state of the art this discovery was patentable, that any testimony as to what is done now—not under any prior art—with respect to flotation at Chino or any place else, is absolutely negligible. and immaterial and irrelevant.

THE COURT: Apart from the claim of estoppel, is not the issue open to trial, just the same as though the Hyde case did not exist, and the Supreme Court decision did not exist?

MR. GARRISON: I cannot answer that categorically. I will answer yes and no. My notion is this: Say we had a case of a will that was attacked in a suit for ejectment, we will say, between Jones and Smith, and the testimony was taken with respect to the testamentary capacity of the testator, and the case went to the Supreme Court of the state or the United States—the controlling court, and they held that with respect to the facts before them as to transactions with the testator prior to the making of the will they were satisfied that the will should stand, and that with respect to statements made by the testator after he had made the will, they were negligible and inadmissible. Now, we have another litigation in which the same will is brought forward between entirely different parties. We are not contending for one moment that it is not

absolutely proper in our suppositious case, to bring in everything that is relevant, which the controlling court has determined that is relevant, and everything that has to do with the then state of the art, at the time these people made their invention. Everything of that kind is relevant and material, but what occurred afterwards is not material. In our suppositious case, if any statement made by the testator before he made his will bears upon the question and is relevant and should be weighed and determined, and if new facts come forward of that kind they should be received and considered; but having once decided that the will should stand or fall by what could be proven that the man said or did prior to its making, and not after its making, that is the law of the case, and whenever that will comes up, every court should apply that law—that rule of evidence. It is relevant concerning that subject matter.

Now, we, in our own case, after the most careful consideration of the state of the art, have proven it before the court, which of course we cannot vary here. We do not maintain that it is not absolutely relevant for them to prove anything in that line—barring the estoppel—anything concerning the state of the art on which to base the claim that it is not an invention. When the Supreme Court said we are right, and applied the correct rule of law, namely, what was the state of the art at the time this invention was made—they found that at that time this invention was patentable. Now, to go forward and say they are going to vary that by showing what has happened since by using a greater quantity of oil or a less quantity of oil, can-

not affect this question. The Supreme Court said that in the then state of the art it was an invention, and we believe, even though you specify the amount of oil in their patent—they said you have a valid patent for that in the then state of the art. Now, is it possible that they should be allowed to bring testimony to vary that by anything that has happened after the time of the discovery and the time at which the Supreme Court determined that at that time it was a discoverable invention?

THE COURT: There are lots of cases on that point, probably. Has not that issue been up many times?

MR. GARRISON: In one way it could not have come up before, and in another way it may have been up many times. I am arguing apart from the question of estoppel, that that is the law of this case. We have to take the state of the art which the Supreme Court have used and they said "Under the then state of the art this was a pantentable invention." I suffer somewhat under the same disability that your honor mentioned yesterday, of not knowing very much about patent office terms. They said "We determine that in the then state of the art that this was a patentable discovery." How can they possibly be permitted to put in testimony as to what can be done with greater quantities of oils or less quantities of oils or different quantities of oils subsequent to the date of that decision.

THE COURT: It looks as if it ought to be so. The question is whether it is so.

MR. GARRISON: I am arguing that it is so, and I leave it to your honor to say whether it is so. Mr.

Scott says frankly that this is all the evidence that he has got, but he is going to bring a vast amount of testimony as to what can be done by varying the quantities of oil, by the use even of vast quantities of oil.

THE COURT: He wants to show by new evidence and by inferences drawn from the former evidence that the conclusions arrived at were wrong.

MR. GARRISON: The Supreme Court reviewed the former evidence, and reached a conclusion that this discovery was novel, in the then state of the art. They say "We find that at the time the people made this discovery that the state of the art was such that this invention was discoverable."

THE COURT: Not what might have been done there, but the state of the art? Well, there must be cases. It seems to me that that issue ought to have been up in many cases.

MR. SCOTT: I don't think, in our view of the matter, that it is a question that requires citations. This witness who testified yesterday, it is exactly the same as any expert witness who would say I made an experiment last night. This experiment which this witness will testify about happens to have been made in a mill. Furthermore, the laws of nature are the same now as they were in 1905. We brought the results of experiments here with different quantities of oil in the Hyde case, and we were criticised because we did not have results of experiment in a mill. Now we have done it in a mill, and they still criticise, and when we have used larger—now we have done it in a mill, and still they criticise, though we have used a larger quan-

tity of oil. As to the prior state of the art, we are merely saying that what there was in the prior art, unknown to the Supreme Court, we should be allowed to show. What we desire to show is what can be done in a mill and what was done in a mill which this witness will testify about, and it is strictly connected with the prior art.

MR. GARRISON: They have not qualified him to testify about the prior art.

THE COURT: I know, but they want him to show by his testimony that what he has done now to strengthen their statement, that that was the prior state of the art, or that it could have been done under the prior art.

MR. GARRISON: I am perfectly fair with the court. I don't want any ruling to be made under a misunderstanding.

THE COURT: Certainly. We want this case tried so it will not come back.

MR. GARRISON: If Mr. Scott had proceeded with his witness, showing that they had done this or that at Chino or elsewhere with the amount of oil larger or different from those under our patent, that would be different. He has not done that. He has produced a gentleman who says he is from Chino, and that his mill has experimented with different quantities of oil. There is not a scintilla of testimony to show that it is under any prior art, and until that is shown, it seems to me that your honor is embarking on an immense field, which is not relevant. I think Mr. Scott should demonstrate first under what conditions of the

prior art this Chino experiment comes, and have the horse in the proper place, before the cart, not after it.

MR. SCOTT: I think the court can trust us to connect up our testimony. This witness knows about the matters about which we are talking.

THE COURT: Has the Supreme Court, in a case to which this defendant is a stranger, rendered an opinion—does that opinion establish the validity of that invention and the prior state of the art or the state of the prior art, so that it binds this defendant and other persons who want to litigate this patent.

MR. GARRISON: Provided nothing is added to the prior state of the art—yes, I can assert that.

THE COURT: Then I would like to hear cases, because if it is the fact, I think it will materially shorten this case. I will give you until tomorrow morning to present cases.

WHEREUPON an adjournment was taken until Wednesday, April 18, 1917, at 10:00 a. m.

WEDNESDAY, April 18, 1917, 10:00 A. M.

Trial resumed pursuant to adjournment, all parties present; whereupon the following proceedings were had:

MR. GARRISON: The precise question under consideration at the hour of adjournment was whether a question addressed by Mr. Scott to the witness, Mr. Wicks, was, in view of the issues in this case and its present condition to be admitted. Mr. Wicks stated that for some twelve years he had been engaged in the business of mining and milling, and that for some five or six years he had been at a plant in New Mexico at the Chino Company. He was asked by Mr. Scott the following question: "Have you operated or had that plant operated under different conditions as to quantities of oil or other reagent ordinarily termed oil. A. Under a number of different conditions. Q. How do the results compare with different quantities of oil?"

And to that objection was made.

Your honor will recall that in the opening Mr. Scott very candidly and very clearly set forth what they proposed to prove in this case, and tendered this as his first witness to prove that which in his opening he stated they were going to prove. For the purpose of accuracy let us see just what issue Mr. Scott has tendered in this case, and the only issue. He says on page 190 of the transcript of testimony: "So inconsistent is the position of this plaintiff in this court with its position in the Supreme Court of the United States, that they do not hesitate to absolutely deny and repudiate what they told the Supreme Court, and in attempt-

ing to sustain their patent, when they come here with the fear in their hearts that somebody has made a successful process with over one per cent of oil."

On page 193 he makes it still plainer and says:

"The whole theory of this case (speaking of his own theory) is a matter of manipulation as to how the matter is stirred up, as to whether it sinks or floats. Not only that, but we will show the court, not only in experimental apparatus, but through the evidence of witnesses—we will show this court that commercial froths of greater metallurgical value are produced with larger amounts of oil."

He makes it equally plain on page 196, by saying:

"I think I am entitled to show this court what kind of misrepresentations that decree was founded upon."

So we have a perfectly candid opening. There is not a single proffer of proof in the opening with respect to the state of the art, not one scintilla of statement of the smallest microscopic quantity. He says, "We are going here to proffer proof that the results of the process in suit can now, we have discovered, be obtained by the use of greater amounts of oil."

Now, my contention yesterday, and the one for which your honor asked me to procure authorities was this: That where a court is determining the question of invention, it must look solely to the state of the art at the time the discovery was made; at the time the invention was discovered; and its patentability or lack of patentability depends solely and absolutely upon what the court finds the state of the art to have been at that time. That proposition is so well settled that I doubt if

it requires any citation of authority; if it does I can produce the authority.

My next proposition was that where a patent had gone to the Supreme Court of the United States, and that court, with respect to the then state of the art disclosed to it, had decided as a matter of law that invention was present, and patentability was justified—that decree—that finding binds all courts in this country upon the question of law, and binds all courts in this country upon the same state of facts, irrespective of who the party to the initial or subsequent litigation is; that is fully vindicated by authority.

The principle has even gone deeper and in the District and Circuit Courts of the United States wherever a patent has been investigated by any one of such courts and a subsequent trial between different parties discloses the same state of facts, the ruling will be the same. We find, rather remarkably, that this has even been raised and decided by a plea in McCloskey v. Hamill, 15 Fed. Rep. 750, Cir. Ct. Southern District of New York, February 19th, 1883. This is a bill in equity, recites the alleged infringement of letters patent No. 220,767. "This patent has twice been the subject of examination by Judge Wheeler in the Circuit Court for this district, McCloskey v. Dubois, and McCloskey v. Dubois and others. The facts which the plaintiff proved upon the second hearing are the same which he relies upon in this case. Judge Wheeler's opinion was that the alleged invention, which is the subject of this patent, is not patentable. That must be taken to be the law of this circuit until either a state of facts is proven which shall present a different case or until the con-

clusion of law upon the facts as now shown shall be overruled by the Supreme Court." The plea is sustained.

In the case of Green v. City of Lynn, 57 Fed. Rep. 516, 518, Circuit Court District of Mass., April 17th, 1893, Putnam, Circuit Judge. "Of course the findings of the Supreme Court in Andrews v. Hovey on questions of law are conclusive on all of the courts. The same is true as to its findings of fact, with reference to any other cause in which the court perceives that the facts are substantially the same as those which came before the Supreme Court. The reasons for this need not be elaborated, but this distinction is to be noted: That, when the parties are not the same in each case the determination of issues of fact by the Supreme Court do not operate strictly as res adjudicata or as a technical estoppel, but merely upon the conscience of the inferior tribunal."

And in Beach v. Hobbs, 82 Fed. Rep., 916, Cir. Ct. District Mass., August 23d, 1897, Putnam Circuit Judge, says: "A decision ~~doctrine~~ by the Circuit Court of Appeals in any circuit, so long as it remains unappealed from, and so long as the Supreme Court has issued no writ of certiorari to re-examine it, is to be regarded as having more effect in other federal courts than that ordinarily given to those of the highest state tribunal or other courts of merely concurrent jurisdiction. This is especially true with reference to a patent for an invention, when the state of the proof remains substantially the same. Yet, when the respondents are not the same, they are entitled to have the facts of their case

carefully scrutinized whether or not they present a different case from that adjudicated in the trial or litigation."

So, we now have gotten, with this brief resume of the situation, the fact that this defendant has not in this case produced any proof, proffered any proof or indicated what proof they propose relying on as to the state of the art at the time of the invention of the patent in suit. And yet they are proffering the testimony with respect to processes which, under the opening, can only have one course attributed to them, and that an immaterial, irrelevant and utterly incompetent issue to be tried in this suit.

Let us assume that they produce from Chino, from Ray, from Inspiration, from any other plant over which they have any authority to exercise control or with which they have any influence to produce witnesses, that they are by some process now, today, producing ore flotation with a greater amount of oil than that specified in the patent in suit. What of it? How is it relevant? How is it material? How can it possibly be taken into consideration by your honor in deciding any issue that is now before you or that can be brought before you under these pleadings?

Under the opening in this case, he stated that he proposed demonstrating to your honor that the Supreme Court of the United States had been deceived in the Hyde suit. I do not know to what he attributed the errancy of the District Court of the District of Montana who fell into the same error. I do not know whether he thought that court had been deceived or not

or fell through natural tendency, but he did say that "we propose showing that the Supreme Court was deceived in the Hyde suit." We do not propose petitioning in that suit, as the law requires we do, to have the court determine whether it was imposed upon. We propose coming into this court; we propose to ignore and set aside the only issues that we have a right to proffer here, and that is the state of the art demonstrating that this was not invention. That charge we do not propose meeting; that charge we do not propose offering. But they say: We do propose showing that now, today at Chino, someone by some process is producing ore flotation with a greater amount of oil than that specified in the patent in suit, an utterly negligible fact, an utterly irrelevant and immaterial fact.

Now, with respect to the authorities on that point: The Privy Council in the Minerals Separation case at page 1349 says:

"It is a general canon of construction, applicable to all documents, that the document should be construed as if the Court had to construe it as of the date of publication to the exclusion of information subsequently discovered. In patent cases the observance of this canon of construction has great importance. It is common, in such cases, to have a number of documents placed in evidence extending over a considerable period of time, each of which is relied on as disclosing relevant information prior to the date of the patent. If these documents required the assistance of experts to aid the Court in construction, the Court is deprived of the benefit of such assistance if the witness is asked to

read the document not in reference to what was known at the date of publication, but to knowledge only acquired at some subsequent date."

In the case of Tannage Patent Co. v. Donallan, 93 Fed. 811, 821, the Court said:

"With the Schultz process before him, it may be possible for a skilled expert to tan a skin by following what he believes to be a *liberal* construction of the Francillon specification, but that is not the question. Francillon is not to be interpreted in the light of and with the knowledge of the Schultz process. The question is, assuming the Schultz process did not exist, does Francillon disclose a tanning process, and by following *literally* his instructions have you solved the problem of a practical and commercial method of chrome tanning?"

Your honor, in the Hyde case, 207 Fed., 956, 961, said:

"The argument that the prior state of the art was such that to anyone skilled therein the process in suit at the time of its discovery was obvious may, under the circumstances, be well answered by the cases:

" 'Knowledge after the event is always easy. * * * But the law has other tests of invention than subtle conjectures of what might have been seen and yet was not.'

Rubber Co. Case, 220 U. S., 435.
Expanded Metal Case, 214 U. S., 381."

In the Schmerts Wire Glass Co. v. Western Glass Co., 178 Fed., 977, 988, the Court says:

"Before attempting to construe it to see whether it was capable of operation, the legal rule governing the case may profitably be examined, to determine whether the Hyatt specification shows definite means for making wire glass. It may not be difficult, in the present state of the art, to read the Schmertz invention into the Hyatt disclosure; but could it have been done in 1874? No one ever succeeded in doing it, and this is some evidence, at least, that the description was defective. Was the original conception that of Hyatt or of Schmertz? By using twentieth century magnifying glasses, a nineteenth century method has been found efficient, which never was so before, and the immensely important point of view of an advanced art is thus unfairly used to discover an original conception never acted on or made anything of, and which never had any practical beneficial existence."

In Naylor v. Alsop Process Company, 168 Fed., 911, 920, the Court said:

"When it is sought to ascertain the state of the art by means of prior patents, nothing can be used except what is disclosed on the face of those patents. Such patents cannot be reconstructed in the light of the invention in suit, and then used as a part of the prior art. That, however, is precisely what the defendants attempt to do in this case in respect to the Frichot patent. . . . . Prior patents are a part of the prior art only by what they disclose upon their face. If they are carried into effect in the industrial world, what is learned from that experience also becomes a part of the prior art. An expert, however, cannot take a process patent,

which has never been applied industrially, and work the process in his laboratory, and discover therefrom something which is not disclosed on the face of the patent, and then transfer that experience back to the time of the patent, and make it a part of the prior art for the purpose of defeating a meritorious invention. That would be *ex post facto* law of the most pernicious character. Such a practice would be especially misleading in a case like the present."

Now, if your honor pleases, it seems to me that the issue now lies plainly before us. There can be no question, and of course we make no question, that it is open to the defendant in this suit to produce anything that lies within his own power, provided his pleadings justify it, with respect to the prior art. We contend, however, that under his opening, under the examination that he has so far made of this witness, it is perfectly apparent that his purpose is not to lay before this court the prior art or anything with respect to the prior art. He has laid no foundation for any such. What he proposes to do is to elicit from this witness, if he is able, and I have no doubt, having regard to his own ability, that he will do it, because he would not have put the witness on the stand otherwise, that by some process now in use at the Chino mill a result which he will claim is similar to the result of the patent in suit is obtained with a greater amount of oil.

And I assert without the slightest fear of being successfully refuted that that is absolutely immaterial in this suit or to any issue that is raised in this suit.

All that Mr. Scott himself says by way of justifica-

tion or excuse for his present method of procedure is: "I must be trusted to connect this testimony." But, if your honor please, orderly course of procedure is a matter of justice, except in negligible particulars. It is laid down for a wise purpose, to effectuate justice. To be sure courts have frequently and very properly ~~frequently~~, where the matter makes no difference, permitted counsel to depart from the orderly procedure; to indulge for their own convenience some other method of proof than that which is the proper method and the proper order; but no court consciously does that in a matter whose inevitable result is absolute injustice to the other side. This method of procedure is, as to us, absolutely unjust and unfair. We are brought here with respect to this defense without the slightest suggestion in the opening as to any issue we are to meet that can be properly tendered by this defendant in this court at this time under the present condition of the law and pleading. We are asked to meet an issue that is immaterial and irrelevant, and that will be ruled out, we respectfully submit, by your honor, the very instant it is frankly and candidly attempted to be brought in.

THE COURT: Let me understand you. You rather seem inclined to concede now that they can proceed to show the prior state of the art was not what the Supreme Court thought it was. Yesterday you rather argued as though that could not be done.

MR. GARRISON: No, sir, no, sir; excepting as to the ground of estoppel—no; my language is right here. You said: "Has the Supreme Court in a case to which the defendant is a stranger rendered an opinion; does

that opinion establish the validity of the invention and the prior state of the art or the state of the prior art, so that it binds this defendant and other persons who want to litigate this patent?"

My answer was: "Provided nothing is added to the prior state of the art, yes."

That is still my position. My position is in this case—they—I concede that if they want to do that and begin by proper proof, to prove the entire state of the art from beginning to end, they can do that.

THE COURT: The court otherwise understood you yesterday.

MR. GARRISON: No, sir; what I was endeavoring to make clear yesterday was this, that until they produce in this court a different state of the art from that before the Supreme Court of the United States, the decision of that court will be followed by this court. Yet in the opening there is no proffer of producing the slightest alteration with respect to the state of the art. The only proffer is to show that now, today, they have discovered—or somebody has discovered that they can take greater amounts of oil than those specified in the patent in suit and obtain the same results. That is the only proffer of proof, and that is the only proof that they propose to show by the witness on the stand, in the question put to him. My statement is that it is proper for them to bring before the court all the proof that is proper under the pleadings with respect to the prior art. If they have done that, and there is nothing before the court that was not before the Supreme Court, the decision of the Supreme Court

finds in this case in the sense in which Judge Putnam stated, and if they do not do that, there is nothing here, and their testimony is immaterial and irrelevant in this suit or to any issue tendered by these pleadings.

Now, returning to the matter I was speaking of a moment ago, I was endeavoring to show your honor the injustice that would result to us by the present order of proof. This gentleman on the stand presumably will swear that at Chino, by a process larger amounts of oil were used than those specified in the patent in suit, and results—let us assume—like those in the patent in suit were produced. Where are we left? Can we intelligently cross examine that witness? Do we know with respect to what part of the prior art that is supposed to relate? We do not. Is there any way of our finding out? There is not. They have not put before the court the state of the art on which they propose to rely. We might spend hours and days cross examining that witness, and have Mr. Scott say "that is all waste of time, because we don't rely on that prior state of the art; we rely on something that you were not astute enough to discover in relation to the testimony of this witness." Can anything be a clearer demonstration of the propriety in this case of the orderly course of procedure? When these defendants have opened to your honor, as I think they should be required to do, what the state of the art is that they propose to rely upon, and when they have proven that state of the art, then it will be time enough,—and not until then—for us to be confronted with practical processes or with so-called experiments. At the present

time we are left in the position where, if this course of procedure is permitted, witness after witness will be put on the stand and will develop their theories without a possibility of intelligent cross-examination on our part, and later, undoubtedly, experts will be called, and they will put their finger on this or that or the other, and will give testimony that we cannot then intelligently cross-examine because they will know nothing of practical operation. They will be able by proving the wrong half of their case first, to deprive us of any intelligent opportunity to meet their case whatever, and I am quite sure that that does not make for the proper administration of justice, and I therefore respectfully submit that our objection is thoroughly well taken at this time, that under the opening of counsel and under the pleadings in this case, under the questions that have been addressed to this witness and answered and under the present question addressed to this witness, it can bring out nothing but irrelevant and immaterial testimony.

MR. SCOTT: If the court please, I must say that I am unacquainted with the practice in the jurisdiction from which my learned opponent comes, but it has always been my experience in the trial of a lawsuit that before the experts are called they ought to have the facts before the court to comment upon, and I have proceeded in what I conceived to be the natural and orderly course of procedure. We have not brought expert witnesses here to testify upon nothing; they must have the ground work of fact upon which to pass their opinions, and it was with that idea that I started my

presentation of the case with a fact witness. Furthermore, we have already a considerable mass of testimony in this case in the Hyde record, which is stipulated in here, and which will be supplemented by further fact evidence. The plaintiff here now has more information regarding what our case is going to be than is usual, simply by reason of the existence of this Hyde record which is stipulated into this case, and it is quite impossible, and quite out of order to put expert witnesses on the stand before we have any facts for them to interpret or comment upon or pass their opinions upon.

As to there being no issue tendered in this case, if Mr. Garrison would look at the pleadings, he would find the issues where they are usually to be found. He would find in them the issues set forth which we are going to present. He would find wherein the issues here tendered differ from those in the Hyde case The testimony which the witness was about to give—and I do not admit that it was necessary it should be so—but it happens to be so by reason of this Hyde record—the testimony which this witness was about to give would have shown that in practical operation the processes of the prior art are practical and are profitable.

As to the statement advanced by Judge Garrison that the decision of one inferior court is binding upon another—one District Court upon another—one Circuit Court upon another—that is too absurd to be entertained a moment. Of course there is a certain comity between the different courts, but it is by reason of the fact that that comity is not always ruling that the

Supreme Court has entertained most of the patent cases which it has entertained, by reason of disagreement between the courts of different districts and different circuits.

I am not altogether clear as to the real ultimate analysis of Judge Garrison's position, but if he has any thought that there is any impropriety in this court entertaining a presentation of the full evidence in this case, it certainly will be removed by a simple consideration of two cases that I have brought with me, and from one of which I will read a paragraph. The first case is Mitchell v. Tilghman, 86 U. S. 287; 22 Law Ed. 125. In that case the Supreme Court of the United States held that a patent issued to Tilghman was not, as it purported to be, for a process, but was restricted to the particular apparatus disclosed, and therefore the case was decided against the patentee, and for the defendant below.

Tilghman in a later case sued Procter & Gamble, that case being commonly known as Tilghman v. Proctor—relating to the same patent. The case is found in the 102 U. S.—I haven't the page—and 26 Law Ed. 279. In this case the same patent was presented to the court; it was the second case involving the same patent. I will read one short paragraph.

"This case involves a consideration of the same patent which was the subject of litigation in the case of Mitchell v. Tilghman, reported in the 19 Wallace 287. The evidence in the present case, which is quite an unwieldly mass, is much the same as in the other, being supplemented however, by the testimony of the patentee

respecting the nature of his original experiments, and the practicability of using practically the coil apparatus described in the patent, together with certain exhibits relating to the novelty of the alleged invention.

"Upon the renewed consideration which has been given to the subject, the court is unanimously of the opinion, contrary to the decision in the Mitchell case, that the patent of Tilghman must be sustained as a patent for a process, and not merely for a particular mode of applying and using the process pointed out in the specifications, and that the defendants have infringed it by the process used by them."

Now, as far as the relation of the first and second trials of these Tilghman cases are concerned, they are on all fours with the case now before the court. In the second case the Supreme Court said 'the record is largely the same but supplemented by certain testimony', and the Supreme Court decided in the second case contrary to that which they had decided in the first case. Now, where we find the Supreme Court entertaining such a record and then reversing its previous decision upon such a record, how can there be any question of the propriety of the lower court following the same procedure?

THE COURT: The argument this morning seems to be that you cannot introduce evidence of what you can do now, without any relation to the prior art?

MR. SCOTT: The evidence which I propose to introduce now is a duplication of the prior art, merely showing its practical application on a practical scale. The criticism was made in the Hyde case that all we

did was to show laboratory experiments representative of the prior art, and the Supreme Court was told that they were shams; that was the word.

THE COURT: This witness whom you have on the stand and by virtue of the question which you have proposed, and others, we will say, like it, are you proposing to show the prior art, and what can be accomplished by it?

MR. SCOTT: Absolutely. I will show by the matters which this witness will describe, as forming part of his practical operations, that each of those different steps is fully described as a step in the prior art, in fact the prior art is already in evidence in the Hyde case, although we will supplement and amplify that.

THE COURT: Proceed, Mr. Scott.

MR. SCOTT: As to the order of proof, your honor, I cannot conceive how I can examine expert witnesses without first putting these facts before the court.

MR. WILLIAMS: I merely wish to say that the facts which this witness will testify to are not facts of the prior art.

THE COURT: Now, he says they are, and we will have to assume that they are.

MR. KREMER: Your honor will have to determine that.

MR. WILLIAMS: He says that the witness will describe experiments performed at a time within the last few months. Now, how can they be facts of the prior art?

THE COURT: It might be. He will say that the prior art was thus and so then, and it could have been

done then, and as corroboration of that, I will show you that it can be done today.

MR. WILLIAMS: How are we to know what facts of the prior art these late facts can be linked up with?

THE COURT: Well, of course, a party may introduce evidence on many occasions where it is absolutely impossible for the other side to meet it, perhaps, but that would not go to its materiality at all; it would be simply your misfortune.

MR. WILLIAMS: Would not that be a misfortune imposed upon the plaintiff by reason of the order of proof not being the regular and proper order of proof? Now, one further objection, your honor, if your honor wishes to hear that before ruling.

THE COURT: Surely. I am going to hear you with the utmost liberality, both sides.

MR. WILLIAMS: The objection to the description by the witness on the stand here of experiments conducted by him at a plant in Chino, New Mexico, when no representative of the plaintiff was present, and which might or might not have been honestly conducted, with no opportunity on the part of the plaintiff to test the operation or its results—our objection is that such testimony of experiments is secondary evidence, and incompetent for that reason; ex parte experiments, done and completed without our knowledge and without opportunity for us to criticise and without opportunity for us to examine the operations. Now, it is peculiarly true that this defendant has a plant in Butte, Montana, within a short distance of the court house,

and that we are here; and if he wants to prove anything by way of experiments, which he says may illustrate the art as it existed twelve or more years ago, why he can produce those experiments in our presence and in the presence of the court, and then we may have some reasonable judgment as to what was done and how it was done. I therefore raise the objection that this testimony of this witness as to experiments performed at Chino is secondary evidence and incompetent.

THE COURT: With reference to the last objection, of course the court will take the circumstances into consideration in weighing the credibility of the witness and how much importance should be attached to experiments of that kind, out of the presence of the plaintiff, and of course to which it has had no access.

The objection made yesterday, the second, is:

"The Supreme Court of the United States having decided that our patent is a valid patent or a patentable invention, any attempt to alter or attack the facts found by the Supreme Court is against the doctrine of stare decisis, and is incompetent and immaterial."

I understood from some of the arguments yesterday that the Supreme Court having found the prior art to be so and so, that that could not be questioned in this case; but I take it from what counsel urged this morning in his argument, and in response to a question of the court, that they do not now and did not then assume that position.

The objection on the score of estoppel—former ad-

judication, in that this defendant was so related to the former suit that it cannot now question the validity of the patent—of course the court still has that in reserve. It is not satisfied from the evidence now to say that this defendant is bound by that decision. At this time, however, on that score, the objection is overruled.

The other portion of the objection going to the testimony of the witness in reference to experiments and practice at the present time—of course if it relates to something happening since this patent, and merely to what might be done now, it will be assumed that it is in the light of what this patent has given, and could have no bearing and no materiality in the case. I think that is made plain by all the cases.

In the matter of counsel's opening statement, it is somewhat of a practice not to criticise it if counsel in the opening statement indulged somewhat in oratory. I do not believe that they can be held—neither they nor the plaintiff—to have fully set out their case in the opening statement, or what they expect to prove. There are cases, or have been, where counsel is held strictly to his opening statement, and upon his opening statement he may be nonsuited if he was the plaintiff, and if he was the defendant it may be ruled that he had no defense. But that has never been the practice here, and I do not believe that it is very favorably considered anywhere any more. Now, the defendant, in proffering this witness says that he does propose by this witness to show the state of the prior art, and what might be done with and under it, and if he proposes

that, of course he has a right to show what it was then, and to corroborate it by what could be done with it now. He says that is his aim and purpose. I think if that is true, it meets the main objection of counsel for the plaintiff. Certainly it is permissible to prove as a circumstance that a thing can be done now—to prove as a circumstance that it could have been done before. If that is all that counsel is aiming at, the court thinks it is admissible.

As to the order of proof, I cannot see that he is proceeding at all out of the proper order, if that is his purpose, to show the former state of the art, and to apply it to what he claims is being done now. In a case like this, a case of such large importance and where the issues are to be so strenuously contested, it is inevitable that the testimony and the evidence will cover a very wide field, and also it is inevitable that some will creep in—considerable will creep in that might not be strictly relevant or material and not strictly in proper order. But the court thinks that when it comes to render its decision, that all this testimony, insofar as it is material will find its proper place, and what is immaterial will probably be excluded, and the court has heard what counsel has said about these experiments. That same question arose in the Hyde suit, and has been commented upon by the Supreme Court of the United States, experiments by one party out of the presence of the other, and to which the other had no access—they may not be entitled to very much weight, but that again is a matter for determination in weighing the testimony and determining the credibility, and not to exclude it as immaterial.

The objections will be overruled.

MR. WILLIAMS: The plaintiff requests an exception.

THE COURT: Let the exceptions be noted.

MR. GARRISON: Just another word. If it shall appear at the conclusion of the direct examination of this witness that for any reason, or for no reason, his testimony is not so referred to the prior state of the art as to direct our attention thereto, we will ask the right to postpone our cross examination of this witness until the connecting testimony is given.

THE COURT: You have always that right, and you have always a right to make motions to strike any testimony that on examination appears to have no place in the record. Recall your witness.

MR. KREMER: That is purely a matter for the discretion of the court.

MR. GARRISON: He has ruled.

Q. 10. MR. SCOTT: Mr. Wicks, I will repeat in substance the question now upon the record: Have you in the operations of the Hurley plant of the Chino Copper Company, used various quantities of oil or oily reagent?

A. We have.

Q. 11. Have your operations involved any comparison of the effects obtained by a more and greater amount of oil?

A. Well, we have prepared certain comparisons, as much for our own information as anything else,

to show the relative effects of the various quantities of oil.

Q. 12. You have before you, have you, a statement of such a comparison?

A. I have.

Q. 13. Covering what period of time?

A. I have a statement here covering the operations of one plant from December 8, 1914, up to December 20, 1916, compared with the same plant from December 21st, 1916 to March 31st, 1917, that division being made because of the marked difference in the operations before and after that date.

Q. 14. That is, a division was made at the end—

A. (Interrupting) at the end of December 20th.

Q. 15. Between December 20th and 21st?

A. Yes, sir.

Q. 16. Now, before December 20th, how were the operations conducted as to the amount of oil used per ton of ore?

A. Well, the operations were conducted in relatively smaller amounts of oil during the major part of the time. There wasn't any great regularity about it, but the quantities of oil varied from a minimum of 1.48 pounds per ton during the third quarter of 1915, up to a maximum of 23.7 pounds per ton which occurred in November—in the middle part of November, 1916.

Q. 17. What days of November was that?

A. November 18, 19 and 20, three consecutive days.

Q. 18. On these three consecutive days the amount of oil was 23.7 pounds per ton?

A. Yes, sir.

Q. 19. Is that figure an average for three days?

A. That is an average for three days.

Q. 20. What was the purpose in using that quantity of oil at that time?

A. Well, necessity, in order to produce results.

Q. 21. Well, just amplify that a little "in order to produce results."

A. That is this quantity of oil was used by the operators in the plant to produce a satisfactory recovery and a satisfactory grade of concentrates.

Q. 22. And at that particular time what would have happened or what did happen with a smaller amount of the particular kind of oil then being used?

A. On this particular day?

Q. 23. Well, what would have happened to the results with a lesser amount of oil than as specified upon these particular days?

MR. GARRISON: I object. I do not see how this witness can speculate if something had taken place other than what did take place.

MR. SCOTT: I will withdraw the question.

Q. 24. ~~What~~ Was the kind of oil used upon November 18th, 19th and 20th 1916, ever used in a lesser amount than 23.7 pounds per ton?

A. May I ask you to repeat that question?

(Question read.)

A. Yes, that same kind of oil was used in lesser amounts.

Q. 25. And with what result as to the efficiency of the operation?

A. Well, with somewhat poorer results. Thinking of the third quarter of 1916, during which we used 8.7 pounds per ton, and the recovery obtained during that third quarter was 96.7 as compared with a recovery during these three days which I have mentioned of 98.4.

Q. 26. And how did the amount of copper in the tailings compare?

A. During the third quarter of 1916 the average tailing for the three months was .306. During these three days the tailings averaged was .244% copper or .062% copper lower by the use of a larger quantity of oil. I would also point out that that was accomplished on a somewhat higher grade ore which of course would ordinarily tend to a higher tailing loss.

Q. 27. Can you state what—or at least in a general way—what oils were used during the period from December 8th, 1914 to December 20th, 1916?

A. We used a tremendous variety of oils. I have a complete list of them but it will take some time to go through that.

Q. 28. It will not be necessary to have a complete list, but if you can indicate in a general way what they were.

A. Just a minute I can.

MR. SCOTT: I may say to the court that the purpose of offering this statement in evidence is for the

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convenience of the court and opposing counsel, I am perfectly willing to furnish copies at this time in order to enable the testimony of the witness to be better followed.

MR. GARRISON: I don't understand he offers it to have any probative force, but merely as illustrative of the witness' testimony. Am I correct in that?

MR. SCOTT: The witness will verify it and another witness will verify the report.

THE COURT: He will supply you copies if you desire. I do not believe the court will care for any now.

A. Going back to my earliest record we used pine oil—it don't say what kind, and a certain creosote, California crude oil, and various combinations of these different oils or various mixtures of these different oils. That was during January of 1915. Then, taking up the next month we used this same combination with the addition of a Texas crude oil.

Q. 29. Were these oils used separately or in a mixture?

A. Both. Sometimes we added each oil separately in order to regulate the proportions of the oils according to the characteristics of the oil and at other time we made up mixtures. For instance, in March of 1915, among the different oils we used, we used an 80% California crude oil and a 20% pine oil. That was used in combination with some creosote, but I am not able to say from this sheet what proportion of the mixture and the creosote we used.

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Q. 30. That is, you used the pine oil and crude in a mixture with some creosote?

A. We used the pine oil and crude as a mixture, that is, being made up in a mixture and fed from one tank, while in another tank we supplied the creosote.

Q. 31. But all three came together?

A. All three came together in the pulp. It is rather difficult to pick these oils out. Calling attention to the new names, we used Oklahoma crude oil in a number of different proportions; Texas No. 4 oil made up in a mixture of 70% Texas No. 4 oil and 20% creosote oil and 10% pine. Is it necessary for me to mention each month as we go down?

Q. 32. I think not. If those that you have stated are representative.

A. Do you wish me to take up any of the more recent practices?

Q. 33. Well, we will come to that later. Now, these operations extending from December 8th, 1914 to December 20th, 1916, were these actual mill operations for profit, or experiments?

A. Oh, those were regular operations.

Q. 34. You might name the tonnage treated during that period, extending down to December 20th, 1916.

A. From December 8th, 1914, to December 20th, 1916, a little over two years we treated 201139 tons or an average of 272 tons per day. I think the average per day will not quite agree with the total tonnage because of the plant being down at times, for a short time. I am not certain as to that, however.

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Q. 35. Now, subsequent to December 20th, 1916, what change was made in the operation of the Hurly plant?

A. Well, we began using, on December 21st, we began using continually a quantity of oil greater than 20 lbs. per ton.

Q. 36. Will you state, for the different intervals after December 21st, how much oil per ton was used?

A. From December 21st to 31st we used an average of 24.57 pounds per ton. That was for 11 days. Then, for the month of January we used an average of 21.10 pounds per ton. In February we used 21.70 pounds per ton, and in March we found it necessary to use 23.73 pounds per ton.

Q. 37. And the average for the entire first quarter of 1917?

A. The average for the entire first quarter of 1917 was 22.18 pounds per ton, and the average for all operations from December 21st, 1916 up to the date of this report, which is March 31st, 1917—at least, that was the date when the figures were closed, was 23.38.

Q. 38. Was that 23.38?

A. Pounds per ton.

Q. 39. Were these operations with over one per cent of oil subsequent to December 21st experiments or actual operations in a mill for profit?

A. They were actual operations performed by the regular operators.

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Q. 40. And will you state what tonnage was treated from December 21st to March 31st, using over 20 pounds of oil per ton?

A. We treated during that period 22,536 tons.

Q. 41. When the change was made from a lesser to the greater quantity of oil, from December 21st, 1916, was the kind of oil changed, or were changes made in the apparatus, or method of operating the apparatus?

A. There was no change in the apparatus or in the method of operating the apparatus at all. The only change was that we began using a larger quantity of a somewhat cheaper oil and a lesser quantity of the more expensive oil. In these records—

Q. 42. (Interrupting.) You are going to state, are you, the oil mixture which you used after the increase in amount; that is after December 21st, 1916?

A. I think I can give it. Before the change was made we were using a combination of Barrett's No. 4 oil, which is a coal tar creosote or generally understood to be a coal tar creosote, and an oil known as the Jones flotation oil, which I think is a Kansas fuel oil. Now, we were using that in approximately the proportion of 90% Barrett oil and 10% Jones oil.

Q. 43. That is, with the smaller or the larger amount?

A. With the smaller amount.

Q. 44. Before December 21st?

A. Using approximately 90% of the Barrett oil, and

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about 10%, I think, of the Jones oil. When we began using the larger quantity, the proportions were almost exactly reversed; that is, we began using only 10% of the Barrett's oil, and about 90% of the Jones. Of course in our operations the character of ore fluctuates a little and these proportions are not absolute from day to day. The operators are allowed some discretion as to the proportions.

Q. 45. Was there any other oil used besides the Barrett and Jones?

A. We used a little pine tar; I don't know the proportion or the quantity, but we have always used that to a very limited extent. That applies both before— That is both during the first 20 days of December and during the last eleven days also. There were eight days during the first twenty days of December, during which they had to use a little pine tar.

Q. 46. That was with the small amount of oil?

A. That was with the small amount of oil, and there two days during the last eleven when they found it necessary to use the pine tar.

Q. 47. Did you operate at any time without the pine oil?

A. Yes, sir.

Q. 48. Simply with the Barrett and the Jones?

A. Yes, sir; both before and after.

Q. 49. Is the use of the pine oil exceptional or general?

A. It is rather exceptional. It is necessary sometimes; we do not know why.

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Q. 50. How did the recovery of metal and the grade of concentrates compare after December 20 and before? That is, with the large and small amount of oil?

A. Well, taking all operations up to and including December 20th, 1916, a little over two years, our average tailings loss in that plant was .48% copper, and the average recovery was 95.528. The average tailings loss for all the period subsequent to December 20th, that is, beginning with December 21st, 1916, was .32% Cu. or .16% Cu. lower than the operating average up to that time; and the recovery for that last period in question was 96.936% or approximately 1.4% higher than the average operation up to that time.

Q. 51. In view of the figures as to the recovery and tailings which you have just stated, are the operations with larger amounts of oil subsequent to December 20th more or less profitable than the operations prior to December 21st with smaller amounts of oil?

A. I haven't the figures here but I have figured it a number of times and I am quite confident that the operations with the larger quantities of oil are considerably more economical, that is, are considerably more profitable, taking costs and the results both into consideration.

Q. 52. In giving your testimony, you have referred, I believe to a written report. Is that correct?

A. Yes, sir.

Q. 53. And this report, a copy of which you have

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in your hands, will you state under whose supervision these operations were carried on?

A. These were carried out under my direct supervision.

Q. 54. And this—And state whether this report was your report, in your official capacity?

A. Yes, sir, it is.

Q. 55. And you know this report to be correct, do you?

A. Yes, sir. I have one of the original reports here and I compared it personally with that so as to be sure that it is all right.

MR. SCOTT: I offer in evidence the report which the witness has referred to in giving his testimony.

MR. GARRISON: May I ask one question before it is admitted?

THE COURT: Yes.

EXAMINATION ON VOIR DIRE,
BY MR. GARRISON:

Q. 56. I understood you to say in answer to a question on direct examination that all of the operations shown upon this paper, which dates from December 8, 1914 to March 31st, 1917, that all of the operations between those dates were carried on by you or under your direction. Is that correct?

A. Yes, sir.

Q. 57. So that you are able to tell us, of your own knowledge, with respect to every operation between those periods?

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A. Well, I was absent from the plant for about six days I think, but I had access to the original reports; and, in discussion with the operators, I have every reason to believe that they are absolutely right because they in no way differ from those results which were obtained during my presence here.

Q. 58. All I want to know is whether you now accept the responsibility with respect to the operation between all these dates, so that when we come to ask you about them you will not say, "I don't know about that operation; I am not the one that you should ask about that operation." You have said all of these were carried on by or under your direction, but if that is not true that is one thing; if it is true that is another.

A. Under my direct supervision.

Q. 59. Does that mean that you are able now, in response to questions, to tell us with respect to each of the operations shown upon this, from the 8th of December, 1914, to the 31st of March, 1917?

A. Perhaps I don't understand you. You want the period first in—I thought you were discussing this period of December 2nd to March 31st.

Q. 60. Now you were asked whether all of these operations about which you had been testifying were carried on by you or under your direction?

A. Well, I may have to correct that. The operations from the first of May, 1915, were carried on under my direct supervision, because I did not go to the Hurley plant until May of 1915.

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Q. 61. Now, from May, 1915, to March 31st, 1917, is it the fact that you have personal knowledge with respect to the matter discussed upon this paper so that, upon cross examination, you are the one who should be asked and can respond to the particular operations? Is that correct?

A. Within the limits I have now made, yes, I think so.

Q. 62. But your knowledge should be complete because you were the person who had complete knowledge; isn't that correct? I am not talking about your memory now; I am talking about your knowledge.

A. I believe I have about as complete knowledge as anyone.

Q. 63. That does not quite answer my question. We do not want to be left in this position: "Yes," you say, "I know all about this" and we admit that paper with that understanding and then when we ask you, have you say "Oh, no, I don't know anything about that; that is outside of my domain." That is what I am trying to elicit from you. Was that all under your knowledge and are you the proper person to be asked concerning the verity of everything shown on that sheet?

A. All of these operations were conducted under my direct supervision and I had at least as much knowledge as to the results and the methods and so on as anybody ordinarily has when they supervise a plant of that size.

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Q. 64. Well, sir, you don't quite answer my question. What I want to know is this:—You can see I am not trying to trap you or anything—I simply want to know whether you are the person from the Chino Company and of whom we should inquire if things which are shown here correctly represent what took place or did not take place.

A. Do you want me to say I am the only person—

Q. 65. I don't want you to say anything but the truth, sir.

A. As I understand your question, I have answered it that I had, I believe, as complete knowledge of these operations and can answer questions just as intelligently as to the operations, as anyone.

Q. 66. Well, have you broad enough knowledge to say whether the facts and other things that are on this sheet correctly represent the facts as they took place at the time that they are purported to have taken place?

A. I think I have.

MR. SCOTT: I will ask, if the court pleases—

MR. KREMER: We want to eliminate three or four lines.

MR. SCOTT: Before the offer is passed upon, to eliminate from this report the first three lines, that is the part from December 8th to 31st, 1914, the first quarter of 1915, and the second quarter of 1915, in view of the witness' statement that his supervision began in May, 1915. And, with that amendment of the report, I will renew the offer.

THE COURT: It will be admitted.

Whereupon the report was admitted in evidence and marked defendant's exhibit 26.

MR. GARRISON: Now, I move to strike out of this witness' testimony all operations prior to May, 1915, when he says his knowledge of the situation began.

MR. KREMER: We consent that that be done. We have eliminated them from this report, everything prior to the time Mr. Wicks took charge.

THE COURT: The motion will be granted.

DIRECT EXAMINATION (Continued)
BY MR. SCOTT:

Q. 67. Referring to this same period of time, what was the nature of the material being treated by flotation?

A. This material was—what is ordinarily known in our plant as the slime vanner concentrates.

Q. 68. And just what is that, in simple terms?

A. In our plant the material is treated on vanners and given a rough concentrating on the vanners or on all the vanners of the plant, and then the finer portions of that vanner concentrate is retreated in this flotation plant under discussion.

Q. 69. The finer portions?

A. The finer portions, yes, sir.

Q. 70. Classified somehow?

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A. Yes, it is classified in hydraulic classifiers and the coarser portion is treated on tables while the finer portion comes to the flotation plant.

Q. 71. Can you state appproximately the degree of fineness of this material treated by flotation, as set forth in this exhibit 26?

A. I have no screen analyses to show, because the material is so fine that a screen analysis does not show up anything; but those that we have taken show approximtely 90% of the material passed 200-mesh, but of course it is still coarse enough to be granular, or partly so.

Q. 72. Do you treat material of any different nature by flotation at the Hurley plant of the Chino Company?

A. We also treat the vanner tailings by flotation, that is, the slime portion of them.

Q. 73. Now, if you can, will you state the quantity of oil that you have used in the different parts in treating these vanner tailings?

A. Well, up to date, our records show that the average quantity of initial oil used was 1.13 pounds of oil per ton of material treated.

Q. 74. THE COURT: How much was that?

A. 1.13 per ton; that is, one and thirteen-one hundredths pounds per ton.

Q. 75. MR. SCOTT: I would like to ask the witness if he has some extra copies of this. I think I will verify it in the same way as the other report, and

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I think it will be more convenient for the court and counsel to have this before them even before it is formally offered.

A. I have three copies.

THE COURT: What is this?

MR. SCOTT: This is a different one, on different material.

Q. 76. You stated, I believe, that up to date you have used 1.13 pounds of oil per ton?

A. Yes, sir.

Q. 77. That is an average covering what period of time?

A. That is an average covering all operations since the 16th of April, 1915, up to the last of March of 1917.

Q. 78. Have you any figures showing the period in which large amounts of oil were used separate from the period where small amounts were used?

A. We segregated certain days, for illustration, during which we used various quantities of oil.

Q. 79. That is the tabulation that appears at the lower part of this sheet?

A. Yes, sir.

Q. 80. I notice that you have used as high as 37 pounds of oil per ton?

A. Yes, sir.

Q. 81. What kind of oil was that?

A. That was a combination of a coal tar with what is known as a stove oil.

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Q. 82. Just those two alone and nothing else?

A. Well, we used a minute quantity of Barrett's No. 4 Creosote oil in conjunction with that, but it happens that this does not show that.

Q. 83. Have you any information as to the part these various ingredients of the oil mixture play in the process?

A. You mean—I don't think I understand your question, Mr. Scott.

Q. 84. Your statement is that you have used a mixture made up of several different oils?

A. Yes, sir.

Q. 85. And the question was as to what part each of these ingredients played.

MR. GARRISON: That is not the question. The question was whether he had the information. If he says he had, we are entitled, before he gives it, to ascertain the source of it.

Q. 85½. MR. SCOTT: Well, state if you have any information on the subject.

A. Yes, sir; I think our experience has given us information on that.

Q. 86. And state, so far as you know, what the effect or function of the different ingredients is.

A. The function of the coal tar is to—well, that acts as the major oil or the collecting oil, if you like. The stove oil, while it probably had some effect in accomplishing flotation, it was also beneficial in diluting this coal tar to the point where it could be fed

into the plant regularly and measured accurately and so on, on account of the consistency of the coal tar, it is rather difficult to handle it alone, even at high temperature. The Barrett oil, I think probably, acted in the formation of the froth to a certain extent, or what is known ordinarily as frothing oils.

Q. 87. Have you any information as to how either one of these ingredients would have acted without the other and in quantity equivalent to that which it was used in the mixture?

A. Yes, I think we have. If you will permit me I might state one instance in connection with our runs.

Q. 88. You may do so.

A. During one of these tests; I can't identify just which one, but I think it was the one of March 27th—

Q. 89. 1917?

A. 1917, which is the fourth one from the bottom on the tabulation, during which we used 32.27 pounds of oil per ton, we used there a combination, or rather we used an oil which we called the Taft oil—it happens to be shipped from Taft, California, —and we used with that a very small quantity of Barrett's No. 4 oil. During that test which represented—or during that run which represented the length of time that the oil lasted, the length of time that the supply lasted, we watched the operation very carefully and I was present on the plant a good many

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hours and I remember that we had been operating steadily for four of five hours and I was up on the flotation machine and the results that the machines were producing were very satisfactory. They were just about as good as we thought we could make them and there wasn't any particular alteration or adjustment being made, and within a minute or two minute's time the forth apparently disappeared right off the surface of the machine and the separation of the finer particles ceased, practically—there were some, but practically none. And so I sent one of the operators down immediately to find out if there was anything wrong in the apparatus below, and he came back and told me that the only thing that was wrong was that the pump which had been pumping the large quantity of that Taft oil, had had to be shut down to have the steam end of the pump packed.

Q. 90. What oil was that pump pumping?

A. That was pumping this heavy Taft oil which we were using in large quantities. Well, of course, I went down right away and watched them until they started to pump again, and in the meantime to satisfy my curiosity, I made sure, personally, that the Barrett No. 4 creosote oil, which was being used in minute quantities, was still being used, and which was being fed independent of the other, in the ordinary manner, was still going into the plant. And so, as soon as the pump was started again I made sure that the correct quantity of oil was going in, that

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is the quantity that we had had on before, because we had good conditions before, was going in, and I went back in the plant and the conditions came back, the same general appearance, that we had before, with absolutely no other change.

Q. 91. Do you remember about what proportions the Taft oil and—what was the other?

A. The Barrett No. 4 creosote.

Q. 92. Barrett No. 4 creosote, were present on that occasion?

A. I don't think we used as much as one-tenth of a pound.

Q. 93. One-tenth of a pound?

A. Yes, sir, per ton of ore.

Q. 94. That has been the customary amount for you to use?

A. No, that is much smaller than the customary amount.

Q. 95. But upon this particular occasion, I mean?

A. On this particular occasion we found it necessary to cut down the Barrett No. 4 creosote oil to that amount to get the correct frothing condition in the plant.

Q. 96. When you talk of a correct frothing condition, precisely what do you mean?

A. Well, what appears to be correct to one operator of course would not appear to be correct to another, but the condition where the concensus of opinion of all present is that we are getting about the best results, just by visual tests.

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Q. 97. What can you say as the absence of a froth with different amounts of oils?

A. It depends on the oils you use, but as a general rule the froth is more abundant with the larger quantities of oil than it is with the smaller quantities.

Q. 98. Does the increase in the quantity of froth ever become objectionable?

A. It does at times.

Q. 99. And what steps are taken at such times?

A. In such a case you either change the oil combination or cut down the quantity of oil.

Q. 100. In treating this slime vanner tailings, was it necessary to make a change in the apparatus or any change in its mode of operation when increasing the amount of oil on January 7th and subsequent days?

A. Well, so far as the actual mechanical equipment was concerned, we made no mechanical changes; that is, so far as the use of apparatus or anything of that kind is concerned, we made no change, but we discovered that we got better results when we used the larger quantities of oil, if we decreased the amount of primary agitation.

Q. 101. To decrease it?

A. Yes.

Q. 102. By preliminary agitation, you mean just what?

A. What we ordinarily term the emulsification in the emulsification plant; that means passing the pulp through machines which serve as mixers only, and

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from which no separation is made. We find the best results are obtained if we shut those down and did not add the oil until the material was about ready to go into the plant. We have also found out that in some of the machines a lower air pressure was better, that is a lesser quantity of compressed air was required to produce the desired results when we were using the larger quantities of oil.

Q. 103. That was in an apparatus of what type?

A. The Janey mechanical air type.

Q. 104. I am referring both to the operations upon the Vanner concentrates and the slime Vanner tailings. I would like to have you describe the apparatus, without going into great detail?

A. It will probably be necessary to take each plant separately, because they are differently arranged. In the treatment of the Vanner concentrates we employ what is ordinarily known as the single Spitzkasten, Janney mechanical machine.

Q. 105. What mechanical machine does—by mechanical machine what are you attempting to distinguish it from?

A. I am attempting to distinguish from what is ordinarily called the air machine, or the mechanical air machine as the case may be.

Q. 106. In this Janney mechanical machine, state briefly what the machine is?

A. It consists of an agitating cell provided with baffles around the cell, in which revolves a pair of

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impellers, mounted on a shaft, which in turn is operated by a vertical motor which sets over the top of the cell, and then alongside of this agitating cell or chamber is the box or Spitzkasten in which the separation is made.

Q. 107. I think I will interrupt you, I would like to ask you to make a sketch as you go along so that the court may get a clearer idea of what that apparatus is?

A. (Witness drawing sketch.)

Q. 108. Now, I think you had better describe that and put letters on it as you go along, and that will give a somewhat better illustration?

A. You want me to hold this in my hand?

Q. 109. I think you can do it that way better, and put letters on there as you go along, and state how the pulp moves?

A. Now, following the manner in which the pulp enters the machine, I might indicate it this way: The feed to the machine enters here at A. The feed passes on into the agitating chamber, which is B, and then these agitators here throw the pulp out against these little baffles which I might mark as C on both sides here, and the agitators I mark as D. In the agitating operation, that causes the material to become mixed with the oil and air and so on, and in the operation it is thrown out into a chamber up here which simply acts as a gathering apparatus. From there it flows into the Spitzkasten in here, which I

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mark F. Now, in this particular machine there are some circulating pipes which come up through this way, and a portion of the material then goes up through these circulating pipes and back into the agitating cell again, and may go around a number of different times before it finally goes out. I will letter the pipes G. There are a pair of them in some of the machines.

Q. 110. Where is the froth taken off?

A. The froth is taken off at what is called the overflow lip, which I will mark H.

Q. 111. Does it simply flow off of itself, or is it scraped off?

A. Sometimes one way and sometimes the other.

Q. 112. What causes the pulp to pass upward through the pipe G and back into the agitating cell?

A. Well, the water level is ordinarily kept up fairly close to the overflow lip.

Q. 113. What keeps it up there?

A. The control of the water level is accomplished by a tailings pipe, a standpipe which regulates the height of the water, because when the water gets up above a certain height the excess overflows, and this overflow pipe I will letter as I. That pipe is adjustable so as to regulate the conditions of the machine. Now, the water level being up here, it forces some of the material to pass back through there.

Q. 114. The pulp is removed, is it, from the agitaing cell by this agitator?

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A. Yes, as the pulp flows in there the agitating plates strike it, and in their operation they take it up and throw it out of the cell.

Q. 115. Then the agitator keeps the agitating cell comparatively empty?

A. Yes. If you look down in there, as you can sometimes through some of the machines through the vent pipe, there you can see it is almost a mist in there; it is thrashed up pretty finely.

Q. 116. It is for that reason that the height of the water in the spitzkasten is sufficient to force the pulp back into the agitating cell?

A. I think so, yes, sir.

Q. 117. What have you represented there at the top?

A. That is the motor, an electric motor.

Q. 118. Now, what kind of cell is that that you have drawn which you call the mechanical cell or mechanical air?

A. It is a mechanical cell of the single spitzkasten type.

Q. 119. A double spitzkasten would be how?

A. It would be simply a representation of this spitzkasten that I have described, and another on the opposite side of the machine.

Q. 120. And it would take the froth from both sides of the machine, instead of from one?

A. Yes.

Q. 121. Can you describe in a general way how

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the mechanical air machine differs from the mechanical machine you have drawn?

A. The mechanical air machine simply has the addition of an air chamber in the spitzkasten which is furnished with low pressure compressed air; the air is added to this air chamber—the top of the air chamber is covered with cotton twill, of a number of thicknesses according to the conditions, and that breaks the air up into very minute particles, and it assists the machine in accomplishing the flotation results.

Q. 122. Simply a box with one side of it cloth, and air supplied to one side so that the air may go out and assist the flotation?

A. Yes.

Q. 123. And that is in to the Spitzkasten?

A. Yes.

Q. 124. And that is what you call a mechanical air machine?

A. Yes.

Q. 125. And without that air box it is a mechanical machine?

A. Yes.

MR. SCOTT: I offer that sketch in evidence, simply as an illustration of the witness' testimony.

Sketch admitted in evidence and marked DEFENDANT'S EXHIBIT 27.

Q. 126. Can you obtain illustrations of these me-

chanical cells that will be a little clearer than your sketch?

A. I think so; at least we can produce blueprints of them.

Q. 127. That might suffice. How does the material that you have referred to as the slime vanner tailings compare in fineness with the vanner concentrate?

A. Well, the slime vanner tailings are considerably finer.

Q. 128. About how much finer; I think you stated that ninety per cent of the vanner concentrates would go through a 200 mesh, didn't you?

A. Yes. It is rather difficult to say just how much finer, but anyway we know that in vanner concentration, the coarser material or the coarser particles have a tendency to go over ~~the~~ with the concentrate, and the finer particles have a tendency to go with the vanner tailings.

Q. 129. And these vanner tailings you would term extremely fine material?

A. Yes.

Q. 130. Fine slimes?

A. Yes.

Q. 131. Now, I notice that the lower part of this tabulation, which relates to slime vanner tailings, I find that your reports of the treatments on various dates will vary, and the amounts of the oil will vary. Will you state how the treatment with these various amounts compares as to efficiency?

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A. As a rule the larger amounts of oil are very satisfactory.

Q. 132. Is that true as to commercial results?

A. Yes, sir.

Q. 133. Now will you state for the record a comparison of the results with large and small amounts of oil, which illustrates your statement?

A. Well, of course it is difficult to average up these tests from these solitary days, because they represent so many different conditions; but I might compare these individual days with the average of our results up to date, if that is satisfactory.

Q. 134. That will be satisfactory.

A. Now, taking March 14th for example, so as not to string it out too long—March 14th we used 22.80 pounds of oil per ton, and on that date the average tailings loss was .48 per cent copper, and that result was obtained from an average ore or material containing .80 per cent copper.

Q. 135. How much tonnage was treated?

A. We treated 122 tons. The reason for the small tonnage was that we only had a small quantity of oil. That compares directly with the average results of our operations up to date, in which we were treating material averaging .804 per cent copper, and the average tailings loss of our operation up to date was .543 per cent copper as compared with .48 copper for this particular run that I was describing. The per cent of the recovery of our operations up to date for

this particular material was 33.139 against this date of March 14th of 41.00; so that for that particular combination of oils, the results were considerably better than the average of our operations up to date.

Q. 136. I notice upon this table with reference to the slime vanner tailings that the indicated recovery varies from—I see 24 per cent here—up to I think the highest is about 37 per cent?

A. 40.49 I think.

Q. 137. 41 there in one instance?

A. Yes.

Q. 138. Will you explain why the recovery is of that order of figures?

A. Well, because of the character of the material treated.

Q. 139. Explain that, please?

A. All of our ores contain—practically all of our ores contain considerable quantities of the oxides of copper and carbonate copper, and in this particular flotation operation it has not been profitable to recover them.

Q. 140. Does the ordinary flotation operation recover these oxides and carbonates, or what mineral does it recover?

A. The ordinary operations recover only the sulphides?

Q. 141. And has that been the case with the operations tabulated upon this sheet of slime vanner tailings?

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A. Yes. While we probably made some recovery of the oxidized material, it probably was very small.

Q. 142. I notice that this report upon the treatment of slime vanner tailings is signed O. Wiser. Who is Mr. Wiser?

A. Mr. Wiser is the metallurgical engineer of the plant.

Q. 143. And how does it happen that Mr. Wiser's signature appears upon this slime vanner tailings sheet, while the treatment of the vanner concentrates sheet was signed by you?

A. It happened that this report was closed up one afternoon when I was down in the plant, and we were anxious to get it out, so Mr. Wiser signed it. It has no particular significance.

Q. 144. You have the same knowledge as to the accuracy of this report of the slime vanner tailings as upon the other reports you testified about?

A. Yes. I noticed that there are a few days there prior to May 1st, 1915, that, of course, I have not direct knowledge of, but subsequent to that—

Q. 145. Do you know who was in charge at that time?

A. Mr. Wiser was directly in charge of the operations at that time.

Q. 146. During those two days?

A. During that period in April there from the 16th to the 30th.

MR. SCOTT: I offer this tabulation in evidence,

and will state that I will have the first entry verified by Mr. Wiser later.

Sheet of tabulations, reports on slime vanner tailings, admitted in evidence and marked DEFENDANT'S EXHIBIT No. 28.

WHEREUPON an adjournment was taken until 2:00 P. M. of this day, Wednesday, April 18, 1917.

Wednesday, April 18, 1917, 2:00 P. M.

Trial resumed pursuant to adjournment, all parties present; whereupon the following proceedings were had:

Q. 147. MR. SCOTT: Mr. Wicks, you stated this morning something in regard to the over-abundant frothing with large amounts of some kinds of oil; with such oils, as I remember, you reduced the emulsification, the preliminary agitation, and reduced the supply of air in those cells that air was supplied to. What was the reason for diminishing the emulsification and the air supply?

A. Well, simply to cut down the over-abundance of froth.

Q. 148. And what is the effect of that over-abundance of froth; in what way is it objectionable?

A. The greater the volume of froth, generally, the greater amount of gangue becomes entrapped in that froth and is carried over.

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Q. 149. Simply on account of the great depth of froth?

A. Of the great depth of froth, yes.

Q. 150. In your plant is there any of the material that first goes off from the spitz boxes returned to the head of the machine?

A. Yes, a portion of it is.

Q. 151. Now, in a general way won't you explain the relation of these machines one to another; for instance you made a sketch of a single one this morning. Tell us how they are arranged in the plant?

A. Well, the machines are ordinarily divided in the plant, or named under three different names or classes. The first machines, or the machines to which the feed passes first, are called emulsifiers, and they serve the purpose of simply agitating the ore pulp with the oil and air and so on, and no separation of the mineral from the gangue is attempted in the emulsifiers.

Q. 152. Are there any spitz boxes connected with these first agitators that you call emulsifiers?

A. No, sir.

Q. 153. They are simply agitators?

A. Simply agitators.

Q. 154. Then, where is the pulp taken?

A. Then the pulp is taken into machines that are called roughers, by virtue of the fact that they produce a rough concentrate, or a low grade concentrate, and after being passed through the roughers—it might pass through one or four or a large number, according to the material treated—

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Q. 155. Those are provided with spitz boxes?

A. With spitz boxes, yes; some are single Spitzkasten and some are double, according to the character of the material. After the feed has passed through the roughers, the reject or gangue constitutes the finished tailing of the flotation operation. The froth or concentrate is called the rough concentrate, and that constitutes the feed to the third group of machines, which are called the cleaners.

Q. 156. That is an entirely separate apparatus?

A. An entirely separate apparatus, but of the same character somewhat; they differ a little according to the kind of work they have to do. The cleaners receive the rough concentrates, and they make a separation in somewhat the same manner, and the froth from the cleaners constitutes the finished concentrate of the flotation operation. The tailing or reject from the cleaners is generally, if not always, returned to the roughers, mixed with the initial feed, that is, it goes back and joins the original feed again, and passes through the roughers, sometimes going through the emulsifiers, and sometimes not, according to the characteristics of the plant, and so on, but anyway it joins the other stuff before the initial feed has been separated in any way.

Q. 157. Why is it that these cleaner tailings are returned to the head of the machine or to one of the roughers?

A. They generally contain a considerable more mineral contents than the average of the tailings loss

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from the roughing plant, consequently there is material enough in them to make them worth retreating.

Q. 158. They are too valuable to throw away?

A. Yes, sir, and we get other benefits too.

Q. 159. Are these returned cleaner tailings what you refer to as the circulating load?

A. That constitutes what we call the circulating load. The circulating load is the water and material and so on—oil and everything mixed—that is called the circulating load.

Q. 160. Is there any other circulating load in your plant, other than the returned cleaner tailings?

A. Sometimes we take the froth from the last machine in the cleaning apparatus and return that as a circulating load through the cleaner, but that is not always done. What we ordinarily term the circulating load is the cleaner tailings going back to the roughers.

Q. 161. Does this circulating load carry considerable quantity of oil, that is, compared to the solids in them and the water, all mixed with it; is there a considerable quantity of that?

A. We have found that it does.

Q. 162. Do you know how much oil in proportion to the solids, in a general way?

A. I can't say exactly the proportion of oil with reference to the proportion of solids, because our determinations have been made in a somewhat different

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manner. We have usually determined the circulating load in proportion or percentage of the quantity of initial oil added, and our figures are kept in that way.

Q. 163. Have you any idea as to what proportion the oil in the circulating load bears to the initial oil?

A. Our determination vary very extensively, not absolutely reliable, but they have given us the impression—and I think it is fairly close—that about one-third of the initial oil in circulation. By that I mean that if you are using, for example, 25 pounds of oil—or say, 24 pounds to make it even figures—if you were using 24 pounds of initial oil, approximately one-third of that comes back as the proportion which constitutes the circulating load, and again passes through the roughing plant.

Q. 164. This adds to the amount of oil shown by the figures that you have submitted?

A. We have found that it has the effect of adding the quantity of oil, yes.

Q. 165. Now, in operating with these large quantities of oil which you have testified to in the mill, did you perform any operations of that kind in the laboratory, or have them performed, with large quantities—I mean at your plant at Hurley?

A. Yes, for a long time in our plant we kept a force of men on that kind of work and performed a great number of experiments on the various products,

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not only the material that is now being treated, but other products also.

Q. 166. And what was the result of your investigations in the laboratory with quantities of oil upwards of 20 pounds per ton?

A. The laboratory results were not very encouraging.

Q. 167. In what way were they not encouraging?

A. We did not suceed in getting satisfactory metallurgical recovery in the laboratory with the big quantities of oil unless we used quantities considerably in excess of commercial possibility.

Q. 168. Haven't you made some figures as to why they were unsatisfactory and what amounts were unsatisfactory in the laboratory, metallurgically, barring out the cost?

A. Well, I have in mind a test conducted with the crude oil and the Jones oil, particularly the Jones oil to which I referred this morning. These were applied to the treatment of the vanner concentrate and in the laboratory it was necessary to use quantities up to 50 and 60 pounds in order to produce results.

Q. 169. When you say "results" do you mean results comparable with those ordinarily obtained in the mill?

A. Well, by that we meant in our work, results that looked encouraging commercially, from a commercial standpoint.

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Q. 170. And what happened when you used, say 21 pounds?

A. We didn't get very satisfactory results.

Q. 171. Did you try less than 20 pounds, too?

A. Yes, we did.

Q. 172. And what happened with less than 20 pounds of these oils you mention?

A. Well, we were able to get very fair results with less than 20 pounds, but of course we found it necessary to use the Barrett oil and other more active oils, perhaps, in order to get the results.

Q. 173. With under 20 pounds?

A. Yes, sir.

Q. 174. But under 20 pounds, with simply these two oils you mentioned—what were they?

A. I mentioned the California crude oil and the Jones oil.

Q. 175. Yes. Now, with under 20 pounds of California crude and the Jones, without the assitance of the Barrett or anything else, who kind of a result did you get?

A. Only fair.

Q. 176. And then just what do you mean by "only fair?"

A. Well, we either got a very poor recovery or we got a very poor tailing.

Q. 177. And were the results acceptable commercially, in either event?

A. No, not with the Jones and California oils used in small quantities, in the laboratory, they were not.

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Q. 178. But with 50 or 60 pounds of this Jones crude and the other oil, you were able to get a fair result, you say?

A. Yes, sir.

Q. 179. A commercial result, was it?

A. Not commercial, because of the big quantity of oil.

Q. 180. Simply on account of the cost of the oil?

A. Yes, sir.

Q. 181. I understand. Now, how did the results in the laboratory that you have just described with this California oil and the Jones oil, compare with the results in the mill?

A. Well, we are finding that we are—Well, we are getting actual commercial results with these same oils or with the Jones oil, in our vanner concentrates plant, with quantities varying from 20 up to 30 pounds. It varies a good deal from day to day.

Q. 182. And is that what you said you could not do in the laboratory, is it not?

A. Yes, sir.

Q. 183. To what do you attribute this difference between the efficiency of these oils in the laboratory and the mill? Have you any explanation?

A. Well, I think it is due mostly to the benefits of the oil in circulation; that is, we get the oil back from the cleaner tails and that oil serves some benefit in assisting in the oiling of the pulp in the initial feed.

Q. 184. When you referred to getting results with

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20 or 30 pounds of Jones oil, you meant 20 or 30 pounds of initial oil?

A. Yes, sir, initial oil.

Q. 185. And when you refer to circulating oil, you refer to this oil, and in placing the amount of oil in the machine?

A. Yes, sir.

Q. 186. That did not take place in your laboratory operations, of course?

A. We didn't get the same results in the laboratory.

Q. 187. Are your laboratory operations of continuous character or simply intermittent in service?

A. These were intermittent in service.

Q. 188. Is there any difficulty in maintaining the necessary oil supply, or obtaining it for operations with large quantities of oil, or can it readily be purchased?

A. We have had no trouble in getting sufficient quantities of oil for our vanner concentrate plant, in which we are using the Barrett oil and the Jones oil; but we have had a great deal of difficulty in getting sufficient quantities of oil for the roughing plant operations, or as we referred to them this morning as the plant in which the slime vanner tailings are treated.

Q. 189. What the nature of that difficulty?

A. Largely a shortage of tank cars and then a shortage of storage capacity at our plant because we could not determine just exactly which of the half dozen different oils were going to be really the very best for our operations and we did not want to lay in a big

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stock of all of the kinds; so we had to gather up oil from different places and we had a great deal of difficulty in some instances in getting the tank cars and in getting the oil delivered, so it has taken quite a little time to get the matter under way.

Q. 190. Now, in these figures which we discussed this morning and which appear upon the two tabulating statements which you used, the oil is given in a column here, "initial oil".

A. Yes, sir, on both tabulations.

Q. 191. "Pounds per ton on both tabulations, which are exhibits 26 and 28, I think. Do the figures given in these columns represent the new oil added for each ton of new feed that goes into the machine, without reference to this circulating oil?

A. Yes, sir, that represents a computation between the total weight of the dry material treated and the total weight of the oil that we actually consumed or actually took out of the tank.

Q. 192. Upon this table giving the details of the treatment of the slime vanner tailings I notice near the lower right hand corner, two figures, two numbers under a heading at the top of the page "Oil in circulation, load, pounds per ton." What do these figures represent and how were they obtained?

A. They represent samples taken of the circulating load during that particular day, and if my memory serves me correctly the samples were taken every two hours during the 24, and then that material was analyzed for oil and we found that the quantity of oil con-

tained in the circulating load was equivalent to 3.2 pounds per ton of total feed to the machine.

Q. 193. On April 4th, that is?

A. Yes, sir.

Q. 194. Then in the next column which is headed "Total oil, pounds per ton", I note the 11.3, which seems to be the sum of the circulating load and the initial oil.

A. Yes, that is the sum.

Q. 195. That for the periods represented in this table which I have not mentioned, nothing appears in the column or in the circulating load, pounds per ton. I take it that no determinations were made, except on these two days when the figures appear?

A. No, sir. We made a determination on January 7th, but we were not satisfied that our method was correct, so we entered it as an approximate quantity. The other days no determination was made.

Q. 196. Was there a circulating load present on these other days when no figures appear?

A. Yes, at all times there was.

Q. 197. Referring again to this statement of the treatment of slime vanner tailings, I will ask you whether the material treated as reported upon this table was selected material, or was it material taken indiscriminately from the supply?

A. Well, you can make no selection in our plant of material; we have to treat what they send us.

Q. 198. This was representative of the slime vanner tailings, was it?

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A. Yes, I believe it was a very fair representation about an average of all the material.

Q. 199. Was there any attempt made to do otherwise than take the material just as it came?

A. No, sir, we took it out in the regular way.

Q. 200. How do these froths compare in appearance, those that are made with larger or smaller quantities of oil, above and below one per cent, say?

A. Well, it depends on the oil used.

Q. 201. Well, you might give us some instance of the particular oils?

A. We have found that the Taft oil which I referred to this morning, and that the sulphur oil to which I referred which was used on April 2nd—we found that the froth of those oils is almost identical with the froth obtained with the use of less than a pound of Barrett's creosote, when the Barrett's creosote is used alone; in fact I doubt very much if anyone going into the plant could distinguish between the two oils, except possibly by the odor.

Q. 202. But some oils you said, I believe, do show a difference in appearance when used in small quantities?

A. Yes; we found that the Jones Fuel oil, which we have found particularly good on the treatment of slime vanner concentrates, is not in any way satisfactory in the treatment of slime vanner tailings, because it produces such a voluminous froth, while it produces a recovery, that it presents more difficulty in treating it in the cleaners.

Q. 203. Then that is its difficulty, when the froth is too voluminous? The difficulty in handling it?

A. Yes. The froth gets entirely out of bounds. It runs out over the launders, and the feed pipes are not big enough and the circulating pipes can't handle it, and we can't handle it in our settling tanks or any place else.

MR. SCOTT: That is all.

MR. GARRISON: We now move to strike out the testimony of this witness, the basis of our motion being the statement of counsel for the defendant on page 240 of the transcript of the minutes, where Mr. Scott in his statement to the court as to what he purposed proving by this witness said: "The testimony which this witness was about to give would have shown that in practical operations the processes of the prior art are practical and are profitable."

On page 243 of the minutes, your honor said, speaking to Mr. Scott:

"The argument this morning seems to be that you cannot introduce testimony of what you can do now without its relation to the prior art.

"MR. SCOTT: The evidence that I propose to introduce now is a duplication of the prior art, merely showing its practical application on a practical scale. (Then a sentence which I will not read).

"THE COURT: This witness whom you have on the stand, and by virtue of the question that you had proposed, and others, we will say, like it, are you proposing to show the prior art and what may be accomplished by it?"

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And the answer was: "Absolutely." Now, we say he has absolutely refrained from showing anything as to the prior art, and under the circumstances his testimony should be stricken out.

MR. SCOTT: I do not propose to examine this witness as to the literature of the prior art. The patent specifications are in existence. I propose to examine this witness on the facts, which will enable an expert to pass his opinion on whether those prior art principles are practicable, and the expert witness cannot do that until I have the facts for him to pass upon.

THE COURT: What principle of the prior art do you apply this to; you have not shown what particular process this is.

MR. SCOTT: Well, I will take one instance of the prior art. The California Journal of Technology, for instance—

MR. GARRISON: It is not in evidence.

MR. SCOTT: I cannot present the whole case at once. One witness at a time is all we can have. The California Journal of Technology about a year and a half or two years before the patent in suit—in that we have a discussion of what is called the Elmore Bulk Oil Process. These writers go on to describe what they have discovered, as follows: They state that if the ore be powdered and mixed with water and oil, and in proportion varying in their different operations, from two per cent to seven or eight per cent—they have a series of experiments—then the mixture is violently agitated, the agitation will have the effect of beating up the mix-

ture so that a foam or froth arises, carrying the mineral. They go on to discuss the permanency of this froth, its effectiveness in concentrating the ore, and in other ways describing the properties of the operations that are carried out today, in a clearer and more concise and more perfect terms than appears in this patent in suit. Now, there is not the slightest deviation between what this witness testified to and what is set forth in that journal. The journal states that the mixture of ore, water and oil as the witness has described it. The journal describes the agitation as the witness has described it, and after that agitation the formation of a froth—after the ceasing of the agitation the formation of the froth with its abundance of air bubbles, the air bubbles carrying the mineral, the same as he describes it. The publication describes the permanency of this froth and its general characteristics as described by the witness. In every respect it conforms. Now, if we were able to present two witnesses simultaneously, I could have met Judge Garrison's objection; otherwise it is impossible. There are the facts, and there is the publication in evidence; and as soon as the orderly presentation of the case permits, what the witness has testified to will be connected with the disclosure contained in this publication. I don't know that this witness ever saw the publication; he may, or he may not.

MR. GARRISON: From what I just read of the proceedings, it is quite obvious that my purpose was perfectly clear, to elicit from counsel for the defendant whether he purposed to give this testimony in this way,

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which he now says he intended, or whether he purposed by this witness demonstrating the state of the art and the practical operation of the same before, and, he, in answer to your honor's question, said that he absolutely intended to do the latter. Now, he absolutely has not done the latter, and we are left in the very situation which I feared. We have not as yet any evidence as to th prior art, which he says they are going to connect this with; we have not yet any evidence in the exposition of that by an expert which he says he is going to produce, to give us a clear understanding of it; so that your honor will observe that it is absolutely impossible for us to cross examine this witness intelligently now because every question that we would ask him would have to be referred to an expert for him to answer. We cannot ascertain from this witness whether or not this illustrates the prior art, because this witness has not been qualified to testify to the prior art, nor has anybody else. So, if your honor is not going to strike the testimony, then we most respectfully request that our cross examination may be postponed until after the expert witnesses have testified in respect to the prior art, to connect it with this testimony.

MR. SCOTT: Counsel is at liberty as fully now as he ever will be to cross examine this witness about what he has testified to. It is not competent to cross examine this witness about prior art, because he has not testified about prior art; he has testified about certain operations. When our expert witness testifies and illustrates the prior art, then counsel can cross

examine the expert about the prior art. There is no use postponing this cross examination so that the witness can be cross examined about something that he did not testify to. He has testified to facts, and he can be cross examined now as well as any other time, and I see no reason for disturbing the orderly conduct of the case for the simple reason that counsel cannot now cross examine the witness on something that he has not testified about, and that is what the entire objection amounts to.

THE COURT: This witness has testified merely to facts which he claims he knows of his own knowledge and from his own operation or the operation of the plant with which he is connected, and has not assumed, himself, to know anything about the prior art; he has told us nothing about it. The statement of the defense is that they will eventually show that what has been done by this witness, as described by him, is a part of the prior art. I think the order in which we are proceeding is satisfactory. As to the cross examination, I cannot see any reason why you cannot cross examine him fully, because he has only testified to his own acts. You may proceed, and if later you want to question him further, you will be given the opportunity. At this time the motion to strike will be denied. Of course, if it appears later on that it has no relation to the prior art, the motion to strike out may be renewed. You may proceed.

MR. WILLIAMS: Before proceeding with the cross examination of this witness, I would like to re-

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quest of counsel for the defendant that we be supplied with specimens of the material of which this witness has testified, the vanner concentrates, the vanner tailings, and the various oils used, which have simply been denominated by their commercial names. May we have those?

MR. SCOTT: These operations extended over two and a half years, but as far as possible we will supply you with anything, and furthermore we should be very glad to have you visit the plant, if you have any objection to this testimony, as you have signified, on account of not having been present during the two and a half years that the witness testified to. We make the offer today that you may visit the plant now, and as far as possible we will supply you with the material asked for.

MR. WILLIAMS: How many days would it take to go to the plant and spend a couple of days there, and delay the trial?

MR. SCOTT: It was absolutely impossible to have you there during the last two and a half years.

MR. WILLIAMS: How soon will you give us the samples?

MR. SCOTT: As soon as possible.

MR. WILLIAMS: I think it will be impossible to finish cross-examining until we have had an opportunity to examine the characteristics of this material about which the witness has testified.

THE COURT: Proceed with the cross examination.

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CROSS EXAMINATION,
BY MR. WILLIAMS:

X-Q. 204. Mr. Wicks, you say you have been associated with mill and metallurgical companies for about twelve years?

A. Yes, sir.

X-Q. 205. And that carries you back exactly to what time?

A. To the fall of 1905, I think, or 1906—I will have to figure it back, because I remember the number of years connection with each plant—I think it was in the fall of 1906 when I first became connected with metallurgical operations.

X-Q. 206. And at what plant?

A. I was first employed at what is now the Midvale plant of the United States Smelting & Refining Company.

X-Q. 207. And what was your position there?

A. During the first part of the time I was doing clerical work under the direction of the master mechanic; and then, before the plant closed down, which it did in 1907, I was made assistant master mechanic.

X-Q. 208. And your work was in the mill?

A. No, only part in the mill there; we had a small mill there, and my work was scattered throughout the plant, which was a mill and smelter and all that goes with it.

X-Q. 209. You had nothing to do with flotation at that time?

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A. No, sir, nothing at all.

X-Q. 210. Then you say that during the next five years your duties were both mechanical and metallurgical. Was that in the same plant?

A. No, sir, I was with the Utah Copper Company at the Garfield plant.

X-Q. 211. What was your position during that time?

A. I had the title of plant engineer during most of the time that I was there, in fact I did during all the time except the first two or three months, while they were trying me out.

X-Q. 212. That would run from 1908 to 1913?

A. I went there in April in 1908, and my connection with the Utah Copper Company ceased in November, 1912.

X-Q. 213. Any experience with flotation there?

A. Experimentally, only.

X-Q. 214. During what part of the term of your employment?

A. I can't recall just when it was that we first began to give consideration to flotation. I know I had been there a number of years—or at least I had been there some time when flotation was first discussed as far as I know. Of course my position was pretty much subordinate there, and there were lots of things going on around the plant of which I did not know anything. But it was sometime after I had been there, I know, that flotation was first discussed.

X-Q. 215. Then you said that in the next three years you had supervision over mill operations. Where was that?

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A. At Butte; at the Butte and Superior Copper Company, now—

X-Q. 216. (Interrupting) "now Mining Company." And now, what was the period of that experience?

A. I came to Butte in October, 1912, but I did not become associated with the company until December of 1912.

X-Q. 217. And then you continued with them?

A. I continued with them until April of 1915.

X-Q. 218. You had supervision over their mill?

A. I was mill superintendent.

X-Q. 219. Mill superintendent of the Butte & Superior Company for a period of three years?

A. Yes, sir.

X-Q. 220. I presume you had quite some experience with flotation?

A. Considerable.

X-Q. 221. When you came to work there, the flotation plant was installed?

A. It was operating intermittently.

X-Q. 222. At Butte?

A. Yes, sir.

X-Q. 223. And when you left the Butte and Superior Company where did you go?

A. Went to the Chino Copper Company.

X-Q. 224. And your position there?

A. Is, as I have said, the assistant superintendent of mills.

X-Q. 225. What education had you had in metallurgy and mining and milling?

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A. My education extends only through the high school course, so far as actual schooling is concerned.

X-Q. 226. Not in any technical school?

A. No, none at all, sir.

X-Q. 227. So that your technical knowledge has been acquired by experience?

A. And continuous study.

X-Q. 228. You are famili

P. 2467, After L. 10, insert " A. I had supervision over them, yes sir."

and studying the operations?

A. Yes, sir, to a considerable extent.

X-Q. 230. About what proportions of oil were used in the Butte plant when you were in charge of the milling?

A. Well, we used a number of different proportions. I can't recall the figures off hand, because it was so long since severing my connection with the company, but we used various quantities.

X-Q. 231. You used six pounds to the ton at times, did you not?

A. We went considerably higher than that, if my recollection is right.

X-Q. 232. And your results were not very satisfactory when you went so high?

A. Well, that is rather difficult to answer.

X-Q. 233. When did you first acquire a knowledge of flotation concentration of ores?

A. I began to study it along in the early part of

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1912—and while I had had a general knowledge of it before, I hadn't had any especial knowledge, but I began to give it a considerable study in 1912.

X-Q. 234. That was just prior to your employment by the Butte & Superior Company?

A. Yes, sir; I rather anticipated that I would have use for that information, and, while I had read a good deal on it prior to that time, kept up with the general progress of events, as all intelligent men do, I did not give it any special study until along in 1912.

X-Q. 235. Well, first, when did you give it any study?

A. I can't remember.

X-Q. 236. During the early years, say the first two years of your experience in connection with mining and milling, what did you know or learn about flotation?

A. That is too far back, I can't remember that.

X-Q. 237. I show you plaintiff's exhibit 9, what appears to be a copy of a letter signed by you and addressed to Mr. F. G. Janney, manager of mills, Utah Copper Company. Do you recognize that as a copy of a letter written by you, or as the original letter, whichever it may be?

A. Yes, sir, I recognize my signature; I can identify this letter.

X-Q. 238. How did you come to address it to Mr. F. G. Janney, manager, of mills, Utah Copper Company, when it appears to relate to the affairs of the Butte & Superior Company?

A. I don't know what Mr. Janney's connection was

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with the Butte & Superior Company, or whether he had any actual connection, but I know that it was upon Mr. Janney's recommendation that I was transferred to Butte, and he guided me through the first months of my work here, and I frequently consulted with him.

X-Q. 239. Well, isn't this a report about the affairs of the Butte & Superior Company?

A. Yes.

X-Q. 240. The letter is a description of Mr. Hyde's connection with the Butte & Superior flotation operation, is it not?

A. So far as the operations go, yes, it is.

X-Q. 241. How did you come to make this report?

A. He requested me to do so.

X-Q. 242. I read from this letter of yours: "Green has been running a number of tests on the flotation feed to determine the benefit derived by allowing the pulp to stand for a period of time in contact with a weak solution of acid before treatment. He finds that whenever he allows the flotation pulp to stand for an hour or more, with the addition of two pounds of acid per ton of solids that he gets a good tailing and a good concentrate, in the laboratory machine, regardless of the percentage of slimes and using from four to six pounds of oil per ton of ore. His tests have been so successful that we are now preparing to handle the mill pulp in this manner." Does that refresh your memory as to the operations in the mill using from four to six pounds of oil to the ton of ore?

A. My recollection is that at that time represented

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a decrease in the quantity of oil rather than being representative of what we had actually been using.

X-Q. 243. But this letter says: "We are now preparing to handle the mill pulp in this manner. Did you do so?

A. I dont' remember whether we did or not. I know that we tried out that scheme of adding acid sufficiently far ahead of the flotation operation and, if my memory serves me correctly, that worked out very nicely, but as to the amount of oil, I do not know.

X-Q. 244. Well, how much do you think it was, about?

A. I wouldn't venture to estimate because I haven't the figures, and a good many things have taken place since then.

X-Q. 245. Hadn't Mr. Janney come to the Butte mill to help out in the operation before this letter was written to him, Mr. F. G. Janney?

A. I think so.

X-Q. 246. But you don't know that he then had any actual connection with the Butte & Superior Company?

A. I don't know just what his connection was, but I know that he more or less directed my work during the first month of my operations at Butte.

X-Q. 247. And this was on September 16, 1913, after you had been there some time?

A. Yes, sir, I had been there several months, yes, sir.

X-Q. 248. Now, can you say that at any time up to we will say September 16, 1913, in the Butte and Superior mill, you used, in commercial operations, about

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four pounds of oil or six pounds of oil to the ton of ore?

A. I don't see that I would be expected to remember these figures because that is a long ways back. I have no doubt but what the records that I kept at that time will show.

X-Q. 249. Will you give me your best recollection on that question?

A. At what particular time?

X-Q. 250. Up to September 16, 1913, the date of this letter.

A. That is the average of all of it?

X-Q. 251. No, no, whether at any time during that period you used in commercial operations in the Butte & Superior plant, either four pounds of oil to the ton of ore or six pounds of oil to the ton of ore.

A. I have my doubts about ever having operated at that low a figure.

X-Q. 252. What is your best recollection as to figures that you did operate on, we will say the lowest figure that you did operate on?

A. I would have to refer to the records, Mr. Williams; without them, I couldn't offer an estimate.

X-Q. 253. Will you look up the records and endeavor to answer the question that I have put to you and that your memory does not enable you to answer?

A. Well, I have no connection with the Butte & Superior Company now.

X-Q. 254. Yes, but you are testifying for the Butte & Superior Company, and it may be that they would be

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kind enough to let you have access to their records of the time when you were superintendent of the mill. Will you endeavor to do so?

A. I will endeavor to do so, but I can't promise to produce them, because I have no connection with the company; no authority to do so.

MR. WILLIAMS: Will counsel endeavor to overcome the difficulty of the witness in getting access to the records of the work done by him?

MR. KREMER: When the witness makes the request we will see.

MR. WILLIAMS: Well, I make the request of you; please see that the witness is supplied with the information?

MR. KREMER: I can't promise you, because I don't know its availability.

MR. WILLIAMS: If available, you will endeavor to give the witness an opportunity to examine those records? Is that right?

MR. KREMER: If it is available in such form that he can get a complete examination, it will be done; otherwise it will not. X Q 254½

MR. WILLIAMS: You testified about certain operations on November 18th, 19th and 20th of 1916, when the amount of oil used was 23.70 pounds to a ton of ore. Is that correct?

A. Yes, sir.

X-Q. 255. You did not describe the oils that were used on that occasion. Will you please do so?

A. We used a combination of Barrett's No. 4 creosote oil and Jones' flotation oil.

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X-Q. 256. In what proportion?

A. I can't say the proportion. Our records do not show. These proportions are varied from time to time because they are added separately and they are added at the discretion of the operator.

X-Q. 257. How are you able to testify as to the oils that were used at that time?

A. The quantities are measured directly and the quantities missing or disappearing from the tanks are checked against the reports of the various foremen, and the various foremen make the measurements themselves in this particular case.

X-Q. 258. What is your record of the particular oils that were used there?

A. Barrett's No. 4 and Jones' oil.

X-Q. 259. What is your record of that? I don't see it in the slip that you have handed me.

A. We have not shown that in that slip; it wasn't considered essential there.

X-Q. 260. Have you a record of it?

A. Yes, sir.

X-Q. 261. On another document?

A. Yes, sir.

X-Q. 262. What is this other document which contains this record that does not appear on the one put in evidence?

A. This is an entry of the results obtained each day during the month of November, in this particular plant. That shows there simply just the summarized results.

MR. WILLIAMS: I am going to request counsel

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to give us access to this detailed statement which gives particulars that do not appear on the one put in evidence.

MR. SCOTT: I think it is sufficient if the witness testified from these records. He has a great, voluminous record, which obviously can not be used to encumber this case. He will answer fully as to any information contained in that.

THE COURT: Counsel has a right to examine that if he desires.

(Whereupon counsel referred to the record held by the witness.)

MR. WILLIAMS: Q. This memorandum at the foot of the list that you have referred to, does that note "kinds of oil used, B" signify Barrett's No. 4?

A. Barrett's No. 4 creosote.

X-Q. 263. J. Jones'; T turpentine; Ch., Chesapeake pine; is that descriptive of the oil used?

A. That was considered sufficiently descriptive for our purpose because these initials appeared here.

X-Q. 264. Oh, then you had in a separate column the initials there describing such oils as were used at that time?

A. Yes, sir.

X-Q. 256. And they show that you used this combination of B and J on November 4th, and so on continuously until November 28th, is that right?

A. Yes, sir.

X-Q. 266. And on November 29th and 30th you do not

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seem to have any record of the kind of oil used; is that right?

A. I think that is an oversight. I think that was possibly Jones' and Barrett's oil, because there are no other oils called for except those that are called for up here. But I can verify that if necessary.

X-Q. 267. How can you verify them?

A. By referring back to the records made by the various shift foremen, the pencil records that were taken.

X-Q. 268. Well, never mind, then. I note that on November 25th the oil pounds per ton is 26.14. That is correct is it not?

A. Yes, sir; that is correct. I remember having referred back to that to make sure of it.

X-Q. 269. And then on November 21st, the day after, the last three of these, the amount of oil was 17.16?

A. Yes, sir.

X-Q. 270. And then on November 17th, the day before these three, the amount was 15.26?

A. Yes, sir.

X-Q. 271. I note also that at the beginning of the month the amount of oil used was 8.06 pounds per ton. Is that true?

A. Yes, sir, I believe so.

X-Q. 272. How do you account for the increase in the quantity of oil which really becomes manifest a day or two before these three that you have spoken of?

A. Well, partly because of the increase in the mineral content, or copper content of the material treated.

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X-Q. 273. Does that show in the table?

A. Yes, sir; that does not account for all of it, however.

X-Q. 274. That is to say, the concentrates were to some extent a little richer, that were fed to this plant?

A. On the 5th of the month, the copper content of the feed to the plant equalled 3.60% copper, but by the 17th of the month it had increased to 10.23% copper.

X-Q. 275. And then on the 18th it dropped down to 9.02% copper?

A. Yes, sir.

X-Q. 276. And the oil went up from 15.46 to 23.98?

A. Yes, sir.

X-Q. 277. So that does not explain it?

A. Partly, yes. There are so many things that may affect it.

X-Q. 278. Under whose direction was the amount of oil increased for that test, we will say, of November 18th, or that work on November 18th?

A. On November 18th—well, that was done under Mr. Wiser's direction, but was done by the various shift foremen in charge of flotation on the three shifts in the mill. On account of the variable character of the material treated they are allowed a great deal of discretion as to the proportion and kinds of oil that they use.

X-Q. 279. You had not commenced, then, to intentionally increase the amount of oil above 20% to see what you could get—20 pounds to the ton of oil, to see what you could do?

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A. We were trying to keep it down just as low as we could.

X-Q. 280. At that time?

A. Yes, sir.

X-Q. 281. Was that the first time in these operations that you ran up to above 2~~8~~0 pounds of oil to the ton of ore?

A. I am unable to say, but I think there are probably times when it went above that. I am not certain. Our metallurgists had been calling attention to the gradual increase in the quantities of oil and we had not been able to understand just what the reason was.

X-Q. 282. One of the oils which, according to this table, was used on that day, is marked on the table, "Jones." What is its full commercial use?

A. I don't know; we call it Jones flotation oil, but whether that is the commercial name or not, I do not know.

X-Q. 283. Do you know whether it is known as Jones' fuel oil?

A. I am not certain. We always call it Jones' Flotation Oil.

X-Q. 284. What kind of an oil is it?

A. It is a moderately heavy petroleum oil; it comes from some place in Kansas.

X-Q. 285. Is it or is it not very nearly in its natural condition?

A. I don't know whether it has been put through a refining process or not, but I believe that it has.

X-Q. 286. Is it a viscous oil or a thin oil?

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A. Somewhat viscous.

X-Q. 287. What is your general recollection as to the proportions of Barrett's and Jones' oil that were used about the time of these operations, to wit, during the month of November?

A. Well, they varied a great deal from day to day. I know that the Barrett's oil generally constituted the major portion of the oil, but not always.

X-Q. 288. Barrett's oil is a creosote?

A. Yes, sir; we have been calling it creosote; I think it is.

X-Q. 289. What kind of an oil is it?

A. I believe it is a coal tar product.

X-Q. 290. And where does that come from?

A. We buy it from the Barrett Company, and they ship it, part of it, from Chicago—I don't remember where they shipped the rest of it from, but I don't know where it is produced.

X-Q. 201. It is the Barrett Company of Chicago?

A. It is the roofing company that goes by the name of "Barrett Company."

X-Q. 292. And that is a sort of a thick, tarry material, is it?

A. No, sir.

X-Q. 293. How would you describe it?

A. It is a fairly thin oil.

X-Q. 294. And who do you purchase the Jones oil from?

A. George B. Jones & Company, I believe.

X-Q. 295. Of?

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A. I don't know their address.

X-Q. 296. Am I right in understanding that you have no record which will enable you to say what the relative proportions of Barrett and Jones oil ~~there~~ were in the operations of November 18th, 19th and 20th, 1916?

A. I have no record here.

X-Q. 297. Is there a record?

A. I think there is. The scratch records should show that. I haven't any doubt but that they will.

X-Q. 298. Will you look up that record and arrange to have it sent here?

A. If you wish me to.

X-Q. 299. And please be prepared to refer to the records for the purpose of completing those operations that you have testified to.

X-Q. 300. On November 18th, 19th and 20th, of 1916, what in general were your mill operations? You have described them only in relation to the flotation plant. What was done with the ore up to the point that it entered the flotation plant?

A. I don't recall that there was anything special on those days.

X-Q. 301. Well, what does the mill do with the ore before it reaches the flotation plant; describe it generally?

A. Well, we crush it and grind it and concentrate it on tables and regrind it in the usual manner, and then we treat it on vanners, either sand vanners or slime vanners or tables, according to the size and character.

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X-Q. 302. But how finely do you grind the feed to the vanners?

A. I presume that there is very little feed—I haven't the record here, but judging from this book I presume that there is very little feed treated by the vanners that is coarser than twenty mesh.

X-Q. 303. And the greater part of it is finer?

A. Yes.

X-Q. 304. But you cannot give a screen analysis of the feed to the vanner?

A. I can produce them, but I haven't them in Butte with me.

X-Q. 305. I think I would like you to let us have those?

A. You will understand of course that conditions vary from time to time.

X-Q. 306. Well, how do the conditions since January 1st, 1917, compare with those existing in November, 1916?

A. There is no important change in that time.

X-Q. 307. The changes that you speak of are merely adaptations from time to time to variations in the ore?

A. Partly, and partly to gradually increasing tonnage, or increasing capacity and efficiency and so on.

X-Q. 308. You did not make any change in your grinding operations when you changed from less than twenty pounds of oil to more than twenty pounds of oil?

A. No, we made no difference in the grinding operations at all.

X-Q. 309. Did you make any other change in the

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treatment of the ore before it reached the flotation plant as a result of the change in the quantity of oil, or in connection with it?

A. No, sir.

X-Q. 310. So that the feed to the flotation plants would be on an average substantially the same with the more than the twenty pounds of oil as it was with less than twenty pounds of oil?

A. Yes. When we had these oils available, we simply put them in, and cut down the quantity of the other oil, without changing the method in any way, except that when we had to cut out certain portions of the plant in order to cut down the tonnage, so that we would have oil enough so that we could make a reasonably good run.

(Whereupon a short recess was taken.)

X-Q. 311. Will you give me a description of the ore that is treated in the Chino mill?

A. It is a copper ore, low grade ordinarily.

X-Q. 312. Running in what percentage of copper during the period of your knowledge, or the general average?

A. For what particular period, Mr. Williams?

X-Q. 313. Well, take the period while you were there?

A. I can tell you approximately in a few minutes—well, a little under two per cent.

X-Q. 314. And what percentage of that is sulphide?

A. The proportion of sulphide varies from time to time. I am unable to say just what the average proportion of sulphide is.

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X-Q. 316. Give it the other way; what proportion is oxidized?

A. My answer would be the same, the proportion of oxidized or carbonate material varies from time to time.

X-Q. 316. The oxidized is usually in the form of carbonate?

A. Part of it is.

X-Q. 317. Any silicate?

A. I have seen specimens of silicate in the ore at various times.

X-Q. 318. Is your oxidized ore a dead loss in your flotation operations?

A. Not entirely so.

X-Q. 319. You float some of it?

A. I think we do.

X-Q. 320. You have not any exact determinations?

A. We have not any exact determinations on that, no, sir.

X-Q. 321. What else does your ore contain besides sulphide of copper and oxidized copper?

A. It contains some native copper.

X-Q. 322. Dou you recover that by flotation?

A. I think we do a little, but it is exceedingly difficult to make any determination of that, because the material going into the flotation plant is so fine that I know of no satisfactory way of making a metallic copper determination of it.

X-Q. 323. There is not very much metallic copper I suppose?

A. The major portion of the metallic copper comes out in the tabling operations.

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X-Q. 324. What else besides native copper, sulphide of copper and oxidized copper?

A. Some cuprite.

X-Q. 325. And what is cuprite?

A. That is an oxide of copper.

X-Q. 326. What are the gangues?

A. Principally silicious gangues.

X-Q. 327. In what condition do you find that gangue as you treat it in the flotation plant?

A. In what size, you mean?

X-Q. 328. Yes. Is it colloidal?

A. A large part of it is as near as we can determine.

X-Q. 329. How do you account for the fact that so much of the oxidized copper goes with the slimes tailings from the vanner, and so little apparently with the finest concentrates?

A. Largely becaues of its relatively lighter character; that is, it is more nearly the gravity of the gangue than the sulphide is.

X-Q. 330. Is there any material that you would call clay in ore?

A. Yes, sir.

X-Q. 331. Is the silicious material of a clayey nature?

A. I never thought of it in exactly that way. Some of the gangue is true quartzite and some of it is granite and some of it is porphyry.

X-Q. 332. Have you any record of the exact analysis, complete analysis of your ore?

A. Of the crude ore, no, sir.

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X-Q. 333. Will you let us have a specimen of your crude ore; that is to say, a specimen that has not been wetted, so that an analysis may determine the condition of the crude ore; dry ground?

A. Dry ground to what fineness?

X-Q. 334. Crushed to a quarter of an inch?

A. If the attorneys are willing for me to do so?

MR. KREMER: We have no objection. We will be very glad to have him do it if he can.

X-Q. 335. You have the permission. Will you do so?

A. I will endeavor to do so.

X-Q. 336. In the operation of your flotation plant since December 20th, 1916, what speed of agitation have you used in the Janney flotation machines that you have described?

A. We used the same speed that we were using before we made no change in that.

X-Q. 337. And what is that speed?

A. The flotation machines are driven by alternating current motors which have a synchronous speed of 600 revolutions a minute. I presume they actually operate at around 560 or 565 revolutions per minute.

X-Q. 338. That is, under the conditions of load?

A. Yes, and under the various electrical conditions obtaining in the plant.

X-Q. 339. What is the diameter of these agitators?

A. I don't remember the diameter—let me understand you; do you mean the diameter of the agitator or of the agitator cell?

X-Q. 340. The diameter of the agitating blades?

A. I think that they are about eight inches and twelve inches but I would not say for certain, because I dont' remember.

X-Q. 341. Have you working drawings of these Janney machines?

A. I haven't them here.

X-Q. 342. Can you produce them—as I recollect you were asked and said that you would. Are you able to produce them?

A. If the attorneys are willing I haven't any doubt that they can be produced. I will endeavor to do so with their permission.

MR. WILLIAMS: Will you produce working drawings of the Janney machines used at the Chino plant?

MR. KREMER: We have no objection to their being produced.

MR. SCOTT: I will get the witness to make you a sketch. I don't know what information he has at hand—

MR. WILLIAMS: He cannot give the dimensions without the working drawings.

X-Q. 343. The lower agitator is of less diameter than the upper, is it not?

A. I think so.

X-Q. 344. Because the lower agitator revolves alongside the baffles and the upper agitator revolves above the baffles, is that right?

A. Yes, sir.

X-Q. 345. I understand that the blades of the agitator are on a shaft which extends down from the motor?

A. Yes.

X-Q. 346. And that the speed that you have given for the motor is the speed of the agitators, is that right?

A. That was my intention, yes, sir.

X-Q. 347. Now, you have not said anything about temperatures in any of these operations that you have described. At what temperatures have you operated during your experience in this Chino mill?

A. We do not make any record of the temperatures.

X-Q. 348. Do you heat your pulp?

A. Occasionally we have heated the pulp leading to the plant which treats the low grade vanner concentrates, but only to a very limited extent, and as far as I can remember it has been a number of months since that was done.

X-Q. 349. Now, take the operation since December 21st, 1916?

A. I feel fairly confident that there has been no heating done during that period, nor for several months before that.

X-Q. 350. And when you did heat, you applied your heat to the feed to the flotation plant which treated the vanner concentrates, is that right?

A. Yes.

X-Q. 351. And you never applied heat to the feed to the flotation plant which treats the vanner tailings, is that right?

A. Yes. We have never tried that.

Frank B. Wicks.

X-Q. 352. How about the thickness of the pulp used during the time that you have been connected with this mill?

A. The thickness of the pulp varies a great deal from time to time. If you wish any specific time I probably could give you that information.

X-Q. 353. Give me November of 1916 first, and then give me some operation since December 20th, 1916?

A. In November, 1916, the average dilution of the pulp, or average per cent of solids, which is the way that we keep it, was 37.03 per cent solids in the pulp.

X-Q. 354. I note now looking at this table that the lowest percentage of solids to pulp occurred on the days November 18th, 19th and 20th. That is true, is it not?

A. No, that is not true. On the 28th there was 29.48 per cent solids in the feed, as compared with the 18th and 19th, a greater quantity of solids in it.

X-Q. 355. And with that single exception the run was much higher for the percentage of solids in pulp?

A. I will call attention to the 25th, when the percentage of solids was 33.2, which was lower than those two days, although higher than the third day.

X-Q. 356. And it was on that day that your oil went up to 26.14 pounds to the ton?

A. Yes.

X-Q. 357. So there seems to be a relation between the percentage of solids in the pulp and the percentage of oil used; that is true, is it not?

A. The matter has not been called to my attention

before. There might be some relation there which I have not discovered.

X-Q. 358. Does not it appear so from those tables which you have before you?

A. I would have to compare them pretty extensively before I would be able to say.

X-Q. 359. Well, take the other low figure of the percentage of solids, and you find the pounds of oil was 18.41. That is right, isn't it?

A. Yes. There may be some relationship there.

X-Q. 360. And we find on the first day of the month 8.06 pounds of oil per ton, and percentage of solids 46.43—I think that last figure is 3. Is that right?

A. Probably it is 46.43. It does not matter really. Yes, sir.

X-Q. 361. And for November 18th, we find the percentage of solids 30.53; November 19th 32.10, November 20th, 26.92. That is true, is it not?

A. Yes, sir.

X-Q. 362. Could you supply us with a flow sheet of your mill?

A. I have no authority to give out the flow sheet of the mill, Mr. Williams.

X-Q. 363. Could you supply us with a flow sheet of the flotation plant?

A. I have no authority to give out any of the flow sheets.

X-Q. 364. But you have described the flow of the material. Can't you let us have an accurate official drawing, such as every mill has, showing just exactly what those flows are?

Frank B. Wicks.

A. I would have to get permission from the general manager, under whose jurisdiction I am.

X-Q. 365. Who is your general manager?

A. Mr. John M. Sully.

X-Q. 366. Did he give you permission to come here and give evidence.

A. He was away from the plant when I left.

X-Q. 367. Will you endeavor to get that permission and produce those flow sheets?

A. I will ask him if he is willing for them to be presented.

MR. WILLIAMS: Counsel gives notice that unless the witness produces the official flow sheet, motion will be made to strike out all of his testimony in relation to the flow of material in the plant, and that covers about the whole of his testimony.

MR. KREMER: We, of course, cannot restrain counsel from making motions to strike, but at this time we state that the witness is upon the stand, and if he is desirous of knowing anything about the flow sheets, he can ask any questions that will call from the witness a response that will describe the flow sheet or the operation of the mill. It is not incumbent on the witness to furnish a picture.

X-Q. 368. Have you got that flow sheet here?

A. I am not certain whether I have or not. I will look—I have one covering a portion of the mill dated January 3rd, 1917.

X-Q. 369. Does that include the flotation part?

A. No, sir, this is the concentrating department.

It shows the upper end or the preliminary operation of the flotation plant, merely as a connector, so as to show where the products from the concentrating department go.

X-Q. 370. So that it shows the flow of the material up to the flotation plant, and the commencement of the flotation plant?

A. Yes, it shows the emulsification into the flotation plant.

X-Q. 371. Will you supply, or permit us to make a copy of that flow sheet?

A. I don't feel that I have authority to do so. It is the property of the Chino Mining Company. With permission I should be very glad to do so.

MR. WILLIAMS: I ask the court to order that we have permission to examine that flow sheet.

THE COURT: What is this?

MR. WILLIAMS: The flow sheet of the mill, showing the manner in which the material is fed to the flotation plant.

THE COURT: Yes, you have it here within the jurisdiction of the court. You will furnish it to the counsel. It is material on cross examination.

MR. KREMER: Of course we have no objection to it whatever. We believe that the statement of Mr. Wicks, appearing of record, will sufficiently protect him in the matter.

X-Q. 372. You have stated that the finer concentrates of the vanner go through the flotation plant. Is that correct?

Frank B. Wicks.

A. The finer portion, I said.

X-Q. 373. What becomes of the coarser portion?

A. That is treated on the tables.

X-Q. 374. Does that ever go to the flotation plant?

A. I think not.

X-Q. 375. Does this flow sheet show what becomes of the coarser concentrates from the vanners?

A. I think that the flow sheet simply shows that it goes to the vanner concentrate retreatment plant. That is a plant which has classifiers, tables and so on. It simply makes notes on the bottom of the flow sheet that the material passes to the retreatment plant; that is all.

X-Q. 376. Where do you add the oil to the pulp in your operations, and if there was any difference before December 21st, 1916, and afterwards, you can explain?

A. As far as I know there is no difference at all, except that in some cases more emulsification was necessary than others.

X-Q. 377. Where do you add the oil?

A. Ahead of the emulsifier.

X-Q. 378. Between the emulsifiers and the vanners

A. Well, directly ahead of the emulsifiers, which of course puts in between those.

X-Q. 379. You have not any regrinding between the vanners and the flotation plant there, have you?

A. No, sir, not at this time.

X-Q. 380. Did you at any time?

A. We never have had.

X-Q. 381. Why did you say not at this time?

Frank B. Wicks.

A. Because we are preparing to regrind the sand vanner concentrates. That is something we have not discussed yet. We are preparing to regrind them, and if possible treat them by flotation.

X-Q. 382. And to add oil during the regrinding?

A. That has not been worked out yet, Mr. Williams; we have not decided.

X-Q. 383. But you do not do anything of that sort, and have not done anything of that sort during the period of your experience at the mill?

A. You mean adding oil during regrinding?

X-Q. 384. Yes.

A. Well, there is always a little oil present in all the circulating waters all through the plant, but we do not go up above the grinding machines and deliberately add oil for the purpose of adding oil to the pulp; but there is always a little oil present.

X-Q. 385. That is to say you have a circulation of water from the tailings back to some part of the mill?

A. Yes.

X-Q. 386. Just describe that please?

A. Well, the desert conditions in that country make it necessary to conserve the water supply by impounding the tailings and returning the water, and that water which is so circulated represents the major portion of our water supply.

X-Q. 387. In practically all parts of the mill?

A. In all parts except where absolutely clear water is required.

X-Q. 388. Have you ever made any analyses of that

Frank B. Wicks.

water, the circuit water, to determine what was in it by way of contamination?

A. We have endeavored to do so, but we never have taken any long drawn-out samples or for any long period, samples for the purpose of analyses. I think we have made analyses from time to time, but whether they are complete or not, I don't know.

X-Q. 389. What generally do they show as to the condition of that circuit water?

A. They show a certain acidity in sulphuric acid and in copper sulphate in solution, and considerable ferrous or ferric compounds.

X-Q. 390. Phenol and cresol?

A. Sometimes.

X-Q. 391. Is the oily reagent emulsified with this water before passing to flotation?

A. Sometimes.

X-Q. 392. Not a general practice?

A. We find it necessary with some oils.

X-Q. 393. And then it passes into the flotation plant and meets the circuit water? Is that right?

A. Let me understand what you mean by "circuit water."

X-Q. 394. Circuit water is the water that has been down through the tailings and has been returned. Clear water is water that has not been through the circuit.

A. Well, of course some of this oil is mixed with circuit water, under that definition, before it goes into the flotation pulp, sometimes.

X-Q. 395. But the point that you had in mind was

that you sometimes agitate for specific purposes before the oil or reagent comes in contact with the ore. Isn't that what you had in mind?

A. Well, I had in mind oil distributed along the circuit water and circulating pulp or circulating loads, the reason I asked you for that definition.

X-Q. 396. What do you call the circulating load—is that the term you used, "circulating load"?

A. That is the cleaner tailings returning to the rougher, as I explained this morning.

X-Q. 397. What might well be called a return of middlings to the rougher?

A. Yes, it might be.

X-Q. 398. Now, sometimes these middlings got to the emulsifiers; is that right, and sometimes they do not?

A. Yes.

X-Q. 399. What oils do you have to treat with this extra emulsification?

A. Any oil that is viscous, that is highly viscous. That is, any of the so called low gravity oils.

X-Q. 400. For example, among the oils that you have named.

A. The Taft oil of California.

X-Q. 401. Now, in this matter of emulsification, what difference has there been, if any, before and after December 21st, 1916?

A. You are speaking of the vanner concentrate cleaner plant, of course?

X-Q. 402. Yes.

Frank B. Wicks.

A. There has been no difference in the emulsification.

X-Q. 403. And in the other plant. I notice you merely give in your list, certain operations on different days. Was that plant running right along?

A. Yes, it was.

X-Q. 404. And under what conditions was it running? You haven't given that in your table.

A. To what plant to you refer, Mr. Williams?

X-Q. 405. The plant that treats the tailings, slime tailings of the vanner?

A. On the other days which we haven't given in this tabulation, some days we run with large quantities of oil and some with small quantities, but we have not been able to get the larger quantities continually and we have had to go back to smaller quantities until we could get a sufficient supply.

X-Q. 406. And all you have given is the selected examples of the use of large quantities of oil on different occasions?

A. Those which we thought would be most representative.

X-Q. 407. Have you a full report of the operations for January? February, March and up to April 4, 1917, from which these selections have been made?

A. I am not certain if I have—I have at least a portion of them, Mr. Williams.

X-Q. 408. You have produced a table showing the operations from March 21st to March 31st, 1917. That is right, is it not?

A. Yes, sir.

X-Q. 409. You have picked out in the list put in

P. 2496, After L. 5, insert " A. Yes, Sir."

A. We were not running on large quantities of oil on all of the days.

X-Q. 411. What was the smallest amount of oil that you used during these days from March 21st to March 30th?

A. .55 or fifty-five one hundredths of a pound per ton.

X-Q. 412. But on March 21st, your record here is 1440 tons of ore treated. Is that right?

A. March 21st we treated 135 tons in this particular run.

X-Q. 413. But on that day, according to the report which you now show me, you treated 1440 tons? Is that right?

A. Yes, sir. That test may have represented about eight hours or such a matter. I don't remember the details of this particular test.

P. 2496, L. 26, insert " this day's operation was selected for the purpose of " before " this "

X-Q. 415. And then the figure of pounds of oil per ton for March 21st, is that the average of the whole day's operation?

Frank B. Wicks.

A. That is the average of the whole day's operation.

X-Q. 416. So that it really shows nothing, in view of the great difference between the few hours which you used 25 pounds to the ton, and the rest of the time?

A. I don't understand what you mean by saying that it shows nothing. It shows the results of this day's operations.

X-Q. 417. But it does not show what was the normal rate of oil per ton when you were using these large quantities?

A. No, this record would not show that.

X-Q. 418. And have you the record which shows that?

A. I don't know that we have a comparison between those two. This represents the average result for the full 24 hours of March 21st, from that plant while that represents the short period during which that test was made, or whatever period it may be—I don't remember the duration. It was probably made on a few drums of oil that we got as a sample for trial.

X-Q. 419. Then, on March 22nd you treated 1680 tons and the oil was present in the amount of .64 pounds to the ton of ore, is that right?

A. The amount of initial oil used that day was .64 pounds per ton of oil.

X-Q. 420. Now, on March 23d your average for the day appears to have gone up and you have no record of that in the selected list that you have given to us. Why is that?

Frank B. Wicks.

A. We did not endeavor to enumerate all of these different runs that we made.

X-Q. 421. Was the run satisfactory—with reference to the particular run with the larger quantity of oil?

A. Well, fairly satisfactory, yes. It compared approximately with the results of the other plant which was operating on the old—or the small quantity method.

X-Q. 422. But it was good—it wasn't good enough to put in the tables? Is that right?

A. I don't take it that way; it probably represented too small a tonnage.

X-Q. 423. Then I see that on March 24th the amount of oil was .60 pounds per ton? Is that right?

A. Yes, sir; we used that quantity.

X-Q. 424. And the next day .56? Right?

A. Yes, sir.

X-Q. 425. And the next day .40?

A. Yes, sir.

X-Q. 426. And the next day is March 27th which you have got in your selected list, and there the entire operations of the day were carried on with a large quantity of oil? Is that right?

A. Yes, sir; we made a full run, I believe, on that day and consequently this record will be identical with that.

X-Q. 427. And then the next day I notice it goes to 9.93, is that right.

A. I believe that that other test ran on through part of the day there, but I am not certain, which probably accounts for that. We used it until the oil was gone and then went back to the small quantity method.

Frank B. Wicks.

X-Q. 428. And so then probably that average for the day is increased by reason of the fact that this large quantity test ran over into that day? Is that right?

A. Very likely; I cannot recall the circumstances, but I think that is probably true.

X-Q. 429. And on the next day you drop down to .55 pounds?

A. Yes, sir, and the recovery was 38.18, and the recovery on the day when we used 10 pounds, or 9.3 pounds, 32.33; and the recovery on the day when we used the .55, which was the smallest quantity, 32.47, so that the results there are very nearly parallel.

X-Q. 430. Does this table show the oils that were used?

A. It shows the kinds of oil used but it does not show the relative proportions.

X-Q. 431. What is this T. C. Sulphur?

A. That is an oil which we purchased over in California from the Tar & McCoomb Company.

X-Q. 432. And it was called Sulphur Oil?

A. I think it was designated that way by the shippers.

X-Q. 433. What kind of an oil is it?

A. It is a very viscous oil.

X-Q. 434. And as to its general nature, aside from its viscosity, its origin or character?

A. It is California oil of some kind.

X-Q. 435. Petroleum?

A. It comes from the California wells.

Frank B. Wicks.

X-Q. 436. Some derivative of California petroleum?

A. I don't know whether it is a derivative or whether it is a crude oil. We have had so many of these oils that it is hard to keep track of them.

X-Q. 437. Now, will you let me see the details of the operations of this slime vanner tailings flotation plant, at the period of the change in the other plant, commencing December 21st, 1916?

A. Do you wish to see the details of the operations of the vanner concentrating plant at the time that we made the change?

X-Q. 438. No, of the tailings plant at the time you made the change in the concentrating plant.

A. That was November 18th, 19th and 20th. Shall I mark that for you?

(Witness marks the record.)

X-Q. 439. Now turn on to December 20th and 21st.

A. There is nothing of importance you want to bring out here?

X-Q. 440. No.

A. December 21st.

X-Q. 441. From December 21st to December 31st on two days you used 1.07 pounds to the ton and the rest of the time it was less than one pound to the ton. Is that right?

A. On one day, the 25th.

X-Q. 442. And the rest of the time it is less than one pound to a ton of ore. Is that right?

A. It appears so.

Frank B. Wicks.

X-Q. 443. Now, give me the period in relation to January 7, 1917, in the slime vanner tailings plant.

A. January?

X-Q. 444. January 7th particularly.

A. January 7th.

X-Q. 445. How many tons of ore did you treat on that day?

A. In one plant we treated 1372 tons, and in another plant 2058 tons.

X-Q. 446. The one that you selected for your special list was in the latter plant, is that right?

A. Yes, sir; I believe there was some special condition about that that made it necessary to take that figure, but just what, I cannot say at this time. The metallurgical results in the other plant were better.

X-Q. 447. Where do you find in your detailed list, the oil percentages, the oil proportions that you have given in your special list, 9.72?

A. I don't find it here.

X-Q. 448. Is that a mistake?

A. That would make it necessary for me to go back to the original record in order for me to determine that. But what I think is---I don't know the reason for that; I can't account for it.

X-Q. 449. So far as you can see, the figures given there is erroneous and it should be 6.05 pounds to the ton, isn't that right?

A. There may be something in the previous—or in the report of that test that brought that quantity up to that. I don't know. These records are taken from

supposedly the same record that this was taken from.

X-Q. 450. Will you look that up and see whether you have made a mistake?

A. Yes, sir.

X-Q. 451. And if you have made a mistake, correct it?

A. It was quite unintentional.

X-Q. 452. In the plant which treats the vanner concentrates as operating commencing December 21st, 1916, what is the condition of the concentrates which you obtained as the finished concentrates, as to amount of oil? Have you any showing as to that?

A. We have no determination on the amount of oil contained in the concentrates. We, so far as I know, have never taken any samples of it.

X-Q. 453. Do you make any effort to get rid of the large amount of oil you have there?

A. No, sir.

X-Q. 454. Do you use over again any of the oil that you get in these concentrates?

A. Well, I presume there is some of the oil in the concentrates that gets back into the mill system from the water which is taken from the concentrates in the de-watering operation.

X-Q. 455. That is to say, these concentrates go into what?

A. We take them first to settling tanks and then from settling tanks to filters.

X-Q. 456. And in the settling tanks the mineral sinks and the water overflows. Is that right?

Frank B. Wicks.

A. Yes, sir.

X-Q. 457. And the oil in excess would be apt to come to the surface would it not, and overflow with the water?

A. Well, I presume that some of the oil must go into solution in the water, probably, and quite likely goes out that way. I can't recall that I have ever seen any free oil actually floating on the water as it runs away from the tank, although such a thing might, although I never have noticed it.

X-Q. 458. So far as your observation goes the insoluble oil sticks to the concentrates in this tank?

A. It appears to. At least I have never seen any free oil floating away.

X-Q. 459. And then from the settling tank, where does the concentrate go?

A. To the filters.

X-Q. 460. And the water that is obtained by that filtration is that used over again?

A. Yes, sir, that goes back in the circulating water system.

X-Q. 461. What is the condition of that water, does it contain any insoluble oil?

A. I can't say whether it does or not. We have never had any analyses of it.

X-Q. 462. You have no exact analyses?

A. No, sir.

X-Q. 463. And that water goes back into the plant?

A. Yes, sir.

X-Q. 464. Now, what you have said as to the flota-

tion plant which treats the vanner concentrates, is or is not that true of the flotation plant which treats the vanner tailings?

A. Well, the concentrates from all the flotation plants are combined and settled and filtered together.

X-Q. 465. Aside from what you have referred to as soluble oil, do you recover any oil in your operations from the concentrates?

A. We do not put the concentrates through any special process for de-oiling, or for removing the oil.

X-Q. 466. From the point of the introduction of oil in either of the plants until the end of the plant, is there any process for taking out and making use of the oil—for taking out the oil from the plant? Does it stay absolutely in the plant and in the pulp from beginning to the end—aside, of course, from what you call the returning of the middlings.

A. Except for the circulating load, there is no effort to remove the oil or dispose of the excess or in any way segregate it from the ore or from the pulp.

X-Q. 467. That is to say the oil that is found in there has to be taken care of in the plant as you have described it. There is no other way to get it out or get it back or save it, or use it over again than what you have described; is that right?

A. No, sir.

X-Q. 468. Yes, sir, it is right?

A. There is no other way—that is, there is no way of segregating the oil from the pulp after it is once added except what the water will take out, and of course the circulating load, which you except.

Frank B. Wicks.

X-Q. 469. You can not tell me how much of the original oil is in the concentrates by any figure or determination that you had at any time made?

A. I don't recall that any such analysis has been made.

X-Q. 470. Take, for instance, before December 21st, was any such analysis made at any time?

A. Not within the limits of my recollection, there was no such analysis made.

X-Q. 471. And since, commencing December 21st, no analysis?

A. We have made a number. We have taken a number of samples and made a number of determinations to sort of give us practice in oil determination

P. 2505, L. 17, insert "or systematic sampling, and systematic determination" after "tion"

determi-

nations?

A. I have none here, I think; I didn't bring them with me. I might have something, and I will see. (Witness refers to his papers). No, sir, I have nothing here.

X-Q. 473. Can you give any record of these determinations and give information in regard to them?

A. If any record was made of them I can get them. They were somewhat in the nature of practice for the chemist and I don't know whether they made records of it or not.

Frank B. Wicks.

X-Q. 474. Do you happen to know how they made the oil determination?

A. No, I don't except I know we experimented with the Soxhlet apparatus, and we made a number of determinations with extraction by ether, by beakers, and then treating the material and so on, that is, decanting the liquor and evaporating the ~~o~~ether.

X-Q. 475. I notice that in your list, defendant's exhibit 28, of the operations in the slime vanner tailings plant you had a heading "Other reagents, pounds per ton," and blank, nothing shown under here. Does that mean that in this plant you never used any other reagents than what you have called oils?

A. I don't believe we have ever used any other reagents in sufficient quantity to represent anything that might be recorded there. We have conducted a number of experiments with different reagents but never anything commercial nor anything of importance.

X-Q. 476. I notice that in your list, defendant's exhibit 28, of the operations of the slime vanner tailings plant, you have a heading "other reagents, pounds per ton," and blanks down under that heading, nothing showing. What is the meaning of that, and what other reagents have you used in your plant other than what you have called oils?

A. I don't know that we have ever used any other reagents in sufficient quantity to represent anything that might be recorded there. We have conducted a number of experiments with different reagents, but

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never anything commercial, or never anything of importance.

X-Q. 477. That is to say, from time to time you have experimented with other reagents, and never made a record of it?

A. The record probably exists, but it was in such minute quantity that in summing up those it was not any more than a bare fraction of a pound.

X-Q. 478. Now in the table showing the flotation operations on the retreatment of vanner concentrates, I see that your heading "other reagents, pounds per ton," is in every instance accompanied by some figures. That is right, isn't it?

A. Yes.

X-Q. 479. Now, what are those other reagents?

A. We used a number of them; I don't know that I can describe them.

X-Q. 480. Have you a record of them?

A. I haven't any record of them here.

X-Q. 481. You could get a record of them?

A. I don't know that I have authority to produce them, but I could get them.

X-Q. 482. What is your general recollection—your best recollection as to the other reagents that have been used?

A. We have used sodium compounds and calcium compounds.

X-Q. 483. What sodium compounds have you used?

A. We have used sodium carbonate and sodium sulphide and caustic soda, which is soda hydroxide.

Frank B. Wicks.

X-Q. 484. What calcium compounds have you used?

A. Calcium carbonate, and we have endeavored to use calcium sulphate.

X-Q. 485. What was the purpose of using these other reagents?

A. To improve the metallurgical results of the operation.

X-Q. 486. To improve the metallurgical results of the flotation operation?

A. Yes, sir.

X-Q. 487. Your list gives under the heading "other reagents, pounds per ton," amount varying from .130 to 6.520 pounds per ton. I will ask you to supply information as to what reagents are described in these figures that you have given in the table that you have produced? Will you make your best effort to obtain that information?

A. I can obtain the information, but with reference to producing it, I would have to obtain permission, of course.

X-Q. 488. Will you endeavor to obtain that permission?

A. I will ask for it.

X-Q. 489. I will ask you later. Have you made any determinations or have you any information as to the oil going out with the tailings that flow out of the flotation plants?

A. No, we have no determinations of that.

X-Q. 490. Has your observation been that any insoluble oil goes out with the tailings?

Frank B. Wicks.

A. I have never seen any—just what do you mean by insoluble oil?

X-Q. 491. Undissolved oil?

A. Well, that would be apparent on the surface?

X-Q. 492. It might be detected on the surface or it might show as an emulsification in the mass?

A. I don't recall that I have ever seen any free oil going out in the tailings stream.

X-Q. 493. The water of the tailings does not go to waste, does it?

A. No, it goes out in the tailings stream leaving the mill, and then goes to the tailings dam and is there impounded.

X-Q. 494. So that water goes back again through the mill?

A. Yes. We always see a limited amount of froth on the tailings stream; we have always seen that, even before we had flotation.

X-Q. 495. That is to say at the dam?

A. No, in the tail race, or the tailings launder leading to the dam.

X-Q. 496. But no free oil as far as you know?

A. As far as I know I never have seen any free oil.

X-Q. 497. As a matter of fact you don't know where all this oil goes to, do you?

A. That is not our object, to find out where it goes to, but to get metallurgical results and make money.

X-Q. 498. But you do know where all this oil goes?

Frank B. Wicks.

A. I don't know.

X-Q. 499. How much do you use per day in your largest oil operations?

A. Well, I can easily figure it, but I don't suppose that it would amount to over two tank cars a day.

X-Q. 500. That would be how many pounds of oil?

A. About 200,000 pounds or such a matter.

X-Q. 501. 200,000 pounds of oil a day?

A. Or possibly a little more.

X-Q. 502. Do you buy that much oil and use that much oil for those days?

A. We have not been able to get it yet, but we will do so as soon as we get it lined up.

X-Q. 503. Now, take a day when you used 200,000 pounds of oil?

A. I said we would use that quantity, using it at the rate that we do use it.

X-Q. 504. Well, that would be true if you were using both your plants: is that your computation—using a large quantity of oil in both your plants, or as you are now doing?

A. Well, I had reference to the tailings plant then, of course. The flotation cleaning plant is operating steadily, because we have oil for that.

X-Q. 505. The vanner concentrates plant, that is operating steadily with large quantities of oil?

A. Yes.

X-Q. 506. How much oil are you using per day in that?

Frank B. Wicks.

A. I can easily figure it from the quantity shown there. For what particular period do you wish?

X-Q. 507. Well, take a maximum day, a maximum oil proportion?

A. It is difficult to pick out a maximum day, because there are great fluctuations in the tonnage treated, as well as in the quantities of oil required.

X-Q. 508. Take the month of March. The average for that month, as you have given it is 23.73 pounds of initial oil per ton of ore?

A. Yes.

X-Q. 509. Now, take the maximum day in the month of March?

A. I haven't the record for the month of March, because that was not completed when I left Hurley.

X-Q. 510. Well, take the maximum that you have?

A. I have in February 23 pounds per ton.

X-Q. 511. Well, here is 23.5?

A. Here is one 23.89.

X-Q. 512. Take 23.89 per ton, and tell me how many tons of oil you fed into that plant on that day?

A. We treated 265 tons, and we fed at the rate of 23.89 pounds per ton. It is a matter of computation. I think I have figured it right. 6330.85 pounds of oil were fed to the plant on that day, in 24 hours.

X-Q. 513. MR. SCOTT: Please state the date and the amount of oil so that the record will be clear?

A. This quantity of oil was used on the 25th of February. The tonnage treated was 265 tons, and we used 23.89 pounds of oil per ton, making 6330.85 pounds in 24 hours.

X-Q. 514. Now, that oil, so far as you know, all went to the concentrates, didn't it?

A. I don't know where it went. It did not particularly concern us, as long as it took that amount of oil to produce the result.

X-Q. 515. What was the weight of the concentrates on that day?

A. 85 tons.

X-Q. 516. And after those concentrates had gone through the filter, what became of them?

A. The concentrates stay on the outside of the filter you know.

X-Q. 517. Well, had gone through the filter treatment. I suppose you refer to the Oliver filter?

A. Yes, the Oliver type; the Portland filter. The concentrates from the filter go to the concentrate bins, and there are loaded out occasionally or conveniently into cars, and from those cars they are taken to the smelter.

X-Q. 518. That is, does your concern sell its concentrates to the smelter?

A. I have no knowledge of the business end of the company, but I have generally understood that they sell their concentrates to the smelter. Just what the agreement is by which they dispose of them I don't know.

X-Q. 519. Have you had any trouble because of the amount of oil in the concentrates?

A. I have heard of none, no, sir.

X-Q. 520. But you would hear about that?

Frank B. Wicks.

A. I might hear of it and I might not. They might mention it to me, and they might not.

WHEREUPON an adjournment was taken until Thursday morning, April 19, 1917, 10:00 a. m.

Thursday, April 19, 1917, 10:00 A. M.

Trial resumed pursuant to adjournment, all parties present; whereupon the following proceedings were had:

MR. WICKS

Resumed the stand for further

CROSS EXAMINATION (Resumed)

BY MR. WILLIAMS:

X-Q. 527. In aswering Q. 45 yesterday, you were asked whether any other oil was used besides the Barrett and the Jones, and you replied that you used a little pine tar and other things, and then in Q. 47 Mr. Scott asked you, "Did you operate at any time without the pine oil", thus changing pine tar to pine oil, probably unintentionally. You answered affirmatively, and in Q. 49 you were asked "Is this use of pine oil exceptional or general?" And you answered "It is rather exceptional." Did you intend to say pine tar throughout those questions and answers, or was pine tar a mistake, corrected by counsel?

Frank B. Wicks.

A. Pine oil, as I generally consider it in my mind, includes all classes of pine oil, steam distilled, destructively distilled, and pine tar oils, and of course there are others too. In this record to which you referred I think where we mentioned pine tar that was pine tar oil, and I think that that was what was under discussion when I was talking to Mr. Scott. As far as I remember that was parallel. We do use occasionally, however, destructively distilled pine oil, which is not considered strictly a pine tar oil, but the use of any of them is rather exceptional.

X-Q. 528. Do you use a steam distilled pine oil?

Q. We have not used any steam distilled pine oil for some time.

X-Q. 529. But you have used it?

A. Yes, I think it was used in actual operation some time ago.

X-Q. 530. Is it any more expensive than the destructively distilled pine oil?

A. I don't know what the comparison is, but I believe that steam distilled pine oil is generally considered a somewhat higher priced product than the destructively distilled.

X-Q. 531. And pine tar is quite a different thing, is it not?

A. It is a somewhat more vicous oil from the distillation of pine woods.

X-Q. 532. Now, between the vanners and the commencement of the vanner concentrates flotation plant, you have a classifier as I understand from your testimony?

Frank B. Wicks.

A. Yes, sir.

X-Q. 533. What kind of classifier?

A. A hydraulic classifier.

X-Q. 534. Is there anything else between the vanners and the flotation plant?

A. Well, we have to thicken the classifier products to a certain extent to bring them down to approximately the right consistency for flotation treatment.

X-Q. 535. Then you have a dewatering arrangement?

A. A set of thickening tanks, to take off the excess water.

X-Q. 536. And in these thickening tanks there is an overflow of the excess water?

A. Yes.

X-Q. 537. That is the way you get rid of it?

A. That goes back into the mill, in circulation.

X-Q. 538. Now, that is all that there is, then, between the vanners and the flotation plant, the classifier and the thickener?

A. Well, of course there are pumps or elevators or whatever may be required to overcome differences in elevation.

X-Q. 539. Well, in this particular plant that you have described, for treating vanner concentrates—

A. Sometimes we operate pumps for that, and sometimes elevators, and sometimes both of them together, to convey the concentrates from the vanners back to the classifiers.

X-Q. 540. Pumps to convey the vanner concentrates to the classifiers?

Frank B. Wicks.

A. From the vanner to the classifiers; yes, sir.

X-Q. 541. Then from the classifier to the thickeners?

A. From the classifiers to the thickeners the material now flows by gravity.

X-Q. 542. And from the thickeners to the flotation plant?

A. Also by gravity.

X-Q. 543. In the first place, where, in that series of operations, is the oil added?

A. That is—after the material leaves the thickening tank it passes into a little storage tank or a little regulating tank just ahead of the flotation machines, and then the oil is added as the material leaves this little storage tank.

X-Q. 54~~6~~4. As it leaves that tank?

A. Yes, sir.

X-Q. 545. So that it is added in the pipes that flow from this tank to the flotation plant; is that right?

A. In the launders.

X-Q. 546. In the launders?

A. Yes, sir.

X-Q. 547. And no other oil is added to the pulp before it reaches these launders?

A. No.

X-Q. 548. Now, those launders go directly to the flotation plant?

A. They go right into the flotation machine, that is into the first emulsifier of the flotation apparatus.

X-Q. 549. Is there any overflow of water between the point where the oil commences to enter the pulp

Frank B. Wicks.

and the point where the pulp enters the first emulsifier?

A. No, sir; there is not.

X-Q. 550. So that every drop of oil that gets into the pulp goes into the flotation plant?

A. So far as I know, every drop of oil that is added to the feed in these launders goes into the flotation machines; yes, sir.

X-Q. 551. About how long are these launders?

A. I think that it is probably about six or eight feet between the feed tank and the emulsifier.

X-Q. 552. Does the pulp flow through the emulsifiers in series?

A. It passes through three emulsifiers in series; yes, sir.

X-Q. 553. One after the other?

A. Yes, sir.

X-Q. 554. There is the same speed of rotation in the emulsifier, in the agitating blades, as in the other parts of the plant?

A. Yes, sir.

X-Q. 555. Then from the emulsifiers it passes how to the first rougher machine?

A. It is fed directly into the machine and the machine throws it out into the spitzkasten.

X-Q. 556. Of course your determination of pounds of oil per ton of solids in the feed or per ton of ore, is made by taking samples of the feed and determining the amount of oil in them and determining the rate of feed? Is that right?

A. Yes, sir, we take periodical samples of the feed as it leaves these feed tanks of which I spoke, and that sample is taken for determination for the tonnage and the pounds of the pulp.

X-Q. 557. Now you take the tailings from the cleaner machine and carry that back to the head of the rougher machines, do you not?

A. You are evidently confusing in your mind between the two plants, Mr. Williams. We were discussing the vanner concentrate cleaning plant, were we not?

X-Q. 558. No, no; I am talking now of the flotation plant; I have left the vanner plant.

A. That is the flotation plant which treats the vanner concentrates?

X-Q. 559. Yes. Now, in the flotation plant that treats the vanner concentrates what becomes of the tailings from the cleaner machines?

A. In that plant, Mr. Williams, we do not operate a separate set of roughers and cleaners as we do in the plant that treats the vanner tailings and which I explained yesterday. The apparatus is somewhat different in the plant treating the vanner concentrates.

X-Q. 560. I don't believe that you have described that separately.

A. I don't think that I was given an opportunity to do so yesterday, Mr. Williams.

X-Q. 561. You may do so.

A. The plant which treats the vanner concentrates receives the feed, as I have described it, and from this

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feed tank. The feed passes through three emulsifiers and then to the first flotation machine. Then it passes through from one flotation machine to another, down through a series of 14 cells and of course a froth is taken off of each spitzkasten belonging to each of the 14 cells. The first few spitzkastens produce a high grade, finished concentrate. The remainder of the spitzkastens, then, they produce a lower grade concentrate which constitutes the circulating load in that plant, and that is returned as a middling back into the first emulsifier by means of an elevator and joins the initial feed. Then the tailings from this plant are sufficiently low to be wasted.

X-Q. 562. You have not given us any determination of the amount of oil that was carried around into this lower grade of concentrates which go back to the head of the emulsifier.

A. I don't know the exact quantity of oil there. I know that some determinations were taken but I never considered the method very accurate. They may have been accurate but they have not been proven to be yet, so that we did not consider them sufficiently important to bring them. However, there is a large quantity of circulating oil.

X-Q. 563. And also a large quantity of circulating material?

A. Yes, sir.

X-Q. 564. Now, as to the vanner tailing plant, there you have cleaner cells and the cleaner machines and the rougher machines, and there you take the tailings

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from the cleaner machines and bring them back to what point?

A. Either ahead of the emulsifier or follow the emulsifier, but in either case they join the initial feed ahead of the first flotation machine.

X-Q. 565. And that carries a great amount of solid material?

A. That carries some, but the solid material—the tonnage of solid material isn't so very great there. The volume of pulp is very considerable but it is very dilute.

X-Q. 566. What determination have you made of the amount of solid material which is thus carried along and fed into the roughers?

A. I don't know that I have this record but I will investigate. I have one sample taken on April 4th in which the cleaner tailings or the circulating load contained, in one case, 6.5% solids, and in another case 6% solids, these two samples being taken on April 4th; and I can't say the period of time over which they covered, but I think that that represented a 24-hour run. April 4th, 1917.

X-Q. 567. Now, have you any determination of the proportion of oil to solids in that circulating load?

A. In that circulating load the total volume of the pulp contained .06 and .07 per cent oil. That percentage is based on the total weight—I said volume, but I meant the total weight of the water and solids together.

X-Q. 568. That gives all the items does it not?

Frank B. Wicks.

A. I think that one would be able to compute the remainder of the figures from that.

X-Q. 569. Now, if in fact the amount of solids carried around from the end of the cleaner machines back to the head of the rougher machines was one third the amount of the solids fed into the rougher machines from the vanners, and if then the proportion of oil in weight that you have given it was one third of the proportion of oil in the original feed, then you would have the condition that the proportion of oil to solids in the rougher machines would be absolutely unaltered by the circulating load?

A. That is true, Mr. Williams. We always take that tonnage of the circulating load into consideration in computing our figures of the total pounds of oil present in the machine, that is, we base it not only on the initial tonnage, but also on the tonnage circulated.

X-Q. 570. But those are not the figures you have given here?

A. They were intended to be.

X-Q. 571. Because you have given the feed to the flotation plant from the vanners. That would be the only proper estimate of the amount of material treated?

A. Pardon me; to which statement did you refer there?

X-Q. 572. The slime vanner tailings?

A. We have only given one absolute figure of pounds of oil in the circulating load.

X-Q. 573. Yes.

A. And in that one we show 3.2 pounds of oil in the

circulating load per ton of initial feed. I think if those figures are computed back, you will find that due allowance was made for the tonnage of material circulated. It is quite a long calculation, however.

X-Q. 574. But your weight in dry tons of flotation headings is 3250?

A. Yes.

X-Q. 575. Your initial oil in pounds per ton is 8.10 pounds per ton of flotation headings?

A. Yes.

X-Q. 576. You have said that the amount of oil in the circulating load is at the rate of 3.2 pounds per ton of flotation headings?

A. Of initial feed, yes; based on 3250 tons.

X-Q. 577. Then you give a total oil pounds per ton as 11 plus 3, but you do not anywhere give the amount of solid material that is carried back and put into the rougher in connection with that oil. That is right, isn't it?

A. I have just given you those figures in reading from this other statement, by which you can compute that.

X-Q. 578. But you did not give them in your tables?

A. It was not considered necessary. It could be given, and I believe that I have—at least it was intended that that should include that circulating tonnage of material just the same as we include the circulating oil.

X-Q. 579. How long would it take you to satisfy yourself that your figures here are based upon the actual amount of material that was going through those rougher machines?

Frank B. Wicks.

A. I can make a computation of that and have it ready for you later, if you wish?

X-Q. 580. I will ask you to do so?

A. Very well.

X-Q. 581. Now, how many tons of pulp was returned on that particular day and in that particular operation from the cleaner to the rougher machines?

A. In one case there were 3888 wet tons of circulating load, combining water and solids, or liquids and solids.

X-Q. 582. On April 4th, 1917?

A. Yes, there was in one case, and in another case, 4165 wet tons.

X-Q. 583. Those are all of your measurements?

A. Yes.

X-Q. 584. Now you have not given a description of the apparatus between the vanner slime tailings and the flotation machine which treats those tailings. Just tell me what that apparatus is?

A. There is none at all—that is, during the greater part of this time. Just at the present time we are sending a little of our exceedingly fine slimes directly from the upper classifiers to settling tanks and then to flotation, which has the effect of bypassing the vanners, but other than that there is no cleaning or preliminary handling or anything between the vanners and the flotation plant.

X-Q. 585. Any classifying?

A. None.

X-Q. 586. All the tailings of the vanners flow directly into the flotation machine?

Frank B. Wicks.

A. As I said yesterday, there is a certain tonnage of vanner tailings that are now too coarse to be treated by flotation, and we are not treating them, because they are too coarse, and because we have not flotation capacity for them.

X-Q. 587. And you are not classifying so as to separate the fine material?

A. Well, they are treated at separate vanners anyway, so the separation takes place before the vanner treatment.

X-Q. 588. And in this slimes flotation plant, what is the exact point of the addition of the oil?

A. Just as the material passes into the emulsifier. Of course sometimes we have found that the oil was not necessary ahead of the emulsifiers, so that the emulsifiers are cut out.

X-Q. 589. Yes, you said that before. Now, I called your attention to what appeared to be an error in your table, yesterday, by comparing it with the original reports?

A. Yes.

X-Q. 590. Have you a correction to make?

A. In investigating that, I satisfied myself that the statement as submitted to the court is correct. The error was one on this other sheet, which was entirely clerical. That was on January 7th. I will call attention to the fact that in making up this statement the clerk divided the oil equally between the two plants, plant No. 1 and plant No. 4, in each case. This is ordinarily satisfactory for our daily operation, and in

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this particular test the statistician in the office was not familiar with the situation, and he divided the total amount of oil equally between the two plants there, which made it six and a half pounds, based on the whole tonnage treated in the two plants, but the correct figure is 9.72 pounds on the 7th for the plant in which the test was operated, and 1.70 pounds in the plant in which the test was not made.

X-Q. 591. That is to say, the test was made in one plant, and in these figures the oil was averaged up between the two?

A. Yes, sir.

X-Q. 592. Then there is another matter that I want you to verify. The total for the fourth quarter of 1915, weight, dry tons of flotation concentrates, is given as 20,842. My calculators tell me that that is a mistake; that the other figures require it to be about 2,084, a difference of some 19,000 tons. Will you verify that?

A. I believe they are wrong, Mr. Williams. I will be glad to check that over sometime if you wish.

X-Q. 593. Will you check that over and tell me later whether or not you are right? There may be some other error that explains it. Just go over that calculation, please?

A. Yes, I will. You don't wish me to calculate that now, do you?

X-Q. 594. No. Now, in this table of flotation operations of slime vanner tailings you have a heading "flotation concentrates," and "weight, dry tons"; is that the weight of the concentrates dry?

Frank B. Wicks.

A. How do you mean, Mr. Williams?

X-Q. 595. Is that the weight of the concentrates alone, or does it include the weight of any liquid oil that may be with them?

A. Well, that would be hard to answer.

X-Q. 596. It is given as dry weight. Now are the concentrates dried, or are they loaded with the oil?

A. Well, I am not able to say how much oil might remain in then and how much might be volatilized in the drying operation.

X-Q. 597. You don't know?

A. No, sir; I have no means of telling that.

X-Q. 598. What is the drying operation that you speak of?

A. That is in drying your samples down for assay and analysis and so on.

X-Q. 599. Not what occurs in the machine itself; that is to say, not the filtration.

A. Well, these dry weights, of course, must be computed from the total amount of flotation concentrates shipped, and those of course must check back with the theoretical amounts from day to day within reasonable limits of accuracy, and all of the dry weights are figured by taking moisture samples of the material loaded in the cars as they are shipped, and then those samples are taken down to the laboratory and dried on a steam plate or in a steam oven, and then the loss in weight in the drying operations is considered the moisture.

X-Q. 600. So that when the samples are taken and

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have been absolutely dried, all the oil has been either driven off or made into a solid?

A. I don't see how the oil has anything to do with it.

X-Q. 601. You don't know what has become of the oil; that is the fact, isn't it?

A. I don't know whether it has volatilized or not, no, sir, and the percentage would be very small anyway.

X-Q. 602. I notice down in your other list you do not give us the dry weight of the flotation concentrates at all; that column is blank?

A. We had no means of segregating those figures there; that can easily be computed back, but as we have not the actual figures, we did not show them.

X-Q. 603. Those figures, if they were computed, might tell us something about the reason for the large quantities of oil, might they not?

A. They can easily be furnished, but it was a physical impossibility to get accurate samples at the time the runs were made.

X-Q. 604. Why?

A. Because it is impossible to segregate this particular concentrate from the remainder of the tonnage being shipped at that time. It would be possible to do so if the equipment at the plant permitted it, but under the present conditions it does not permit it.

X-Q. 605. You mix that up with other concentrates, is that right?

A. Yes.

Frank B. Wicks.

X-Q. 606. So you have not any reliable figures there?

A. No, sir. We could have taken dilution samples, probably, and arrived at approximate figures, or we can calculate that, if you wish.

X-Q. 607. Now, I asked you yesterday to compute the total amount of oil fed to the vanner concentrates plant on a day when the tonnage treated was 265 tons, and you used 23.89 pounds of oil per ton, and then I asked you what was the weight of the concentrates on that day and you gave me the weight 85 tons. Now, I thought you gave me the weight of the concentrates of the plant that we were talking about. Did you?

A. I did.

X-Q. 608. And 85 tons of concentrates were produced on that day from that particular plant, is that right?

A. Yes.

X-Q. 609. From those 265 tons of feed?

A. Yes, I believe that to be reasonably accurate.

X-Q. 610. Why do you say "I believe that to be reasonably accurate?"

A. Well, I did not make the measurements myself.

X-Q. 612. You don't think the method of measurement was accurate, is that the idea?

A. No, I did not mean to infer that at all; I meant that I did not have any direct personal knowledge of it, because I did not take the measurements myself; I had to depend on the boys who operate the plant and take these measurements, to compile these figures for me.

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X-Q. 612. I suppose that is true of a good many of the figures is it?

A. Well, naturally I cannot compile all the figures myself.

X-Q. 613. So that you cannot say of your own knowledge as to a good many of those figures, that they are accurate?

A. I can say that I have absolutely every reason to believe that they are accurate, because I have confidence in my organization.

X-Q. 614. But the work has been done by your subordinates?

A. Necessarily so.

X-Q. 615. Now, these recoveries that show in these figures they are the result of computation, are they not?

A. Yes, in that case they are.

X-Q. 616. And what is the method of computation?

A. I don't recall the formula right now that they use for that. It is that formula, I believe, developed by Dr. Gahl; I think it is the weight of the concentrates times the difference between the assay at the heads and the assay of the tailings, and that product divided by the assay of the heads multiplied by the difference between the assay of the concentrates and the assay of the tailings. That is the standard formula I believe, used in all places.

MR. WILLIAMS: For the present, if your honor pleases, I have proceeded as far as possible in the cross examination of this witness.

Frank B. Wicks.

REDIRECT EXAMINATION.

BY MR. SCOTT:

R-Q. 617. Mr. Wicks, referring to the vanner concentrate table, under defendant's exhibit 26, will you state whether on each and every day of the period between December 21, 1916, and March 31, 1917, the amount of oil used was in excess of 20 pounds per ton? I see we have averages here, and the question is directed to whether each and every day went above 20 pounds.

A. Every day with the exception of one day. I can verify that in a minute—every day except one, 26th of December, when, for some reason they dropped down to 18.18 pounds per ton.

R-Q. 618. Is it an easy matter to feed the oil so that you get a certain predetermined amount per ton?

A. No, sir. It is very difficult to do that. The tonnage varies considerable and the rate at which the oil will flow out of a given ap~~paratus~~erture varies considerable and the smaller the aperture the greater likelihood of fluctuation, so that it is rather difficult to maintain exact tonnages. They maintain the amount of oil more by the appearance of the plant than by the actual volume of oil going in at any one time.

R-Q. 619. Now, referring to the slime vanner tailings tabulation, defendant's exhibit 28, and to the part of the tabulation relating to the experiments between January 7th and April 4, 1917, I notice in some instances the tonnage treated in the experiment runs into

Frank B. Wicks.

the thousands and others into the hundreds only. Were these experiments carried out in different plants or parts of the same plant?

A. They were all conducted in full scale machines, that is, ordinary operating machines, but in three cases there where the tonnage is relatively small we operated only two rows out of eight rows, or one quarter of the total plant.

R-Q. 620. That was March 13th, 14th, and 21st?

A. March 13th and March 21st. The reason for that was that the quantity of oil available for the run was not great enough to make it possible to get a good length of run on the full scale.

R-Q. 621. Before leaving the plant at Hurley to come to Butte, did you come to any decision as to the future mode of operating the plant upon slime vanner tailings as a result of the experiments between January 7, and April 4?

A. Well, the results were all submitted to Mr. Sulley, the manager, and I presume it was on the basis of these results that he issued certain instructions with reference to future operations.

R-Q. 622. And what were these instructions?

MR. GARRISON: I object; how can that be relevant, if your honor pleases.

THE COURT: I think the past operations will serve the purposes of this case. The objection will be sustained.

WITNESS EXCUSED.

OBA WISER, a witness called on behalf of the defendant, having been first duly sworn, testified as follows:

DIRECT EXAMINATION.

BY MR. SCOTT:

Q. 1. What is your full name?

A. Oba Wiser.

Q. 2. What is your occupation?

A. At the present time I have the position of metallurgist for the Chino Copper Company.

Q. 3. Are you associated with Mr. Wicks in your duties?

A. Yes, sir.

Q. 4. You have heard Mr. Wicks' testimony today and yesterday?

A. Yes, sir.

Q. 5. During what period, Mr. Wiser, have you been employed as metallurgist at the Hurley plant of the Chino Copper Company.

A. Since June, 1914.

Q. 6. Are you conversant with the flotation operations which are tabulated upon this sheet, "Detailed Record of Flotation Operations on the Retreatment of Vanner Concentrates", this being defendant's exhibit 26?

A. Yes, sir; I was there when the operations were conducted.

Q. 7. Throughout the period from December 8th, 1914, to date?

Oba Wiser.

A. Well, with the exception of probably two weeks' vacation in 1915 and two weeks' in 1916, I think it was away from the plant.

Q. 8. You were there during the first half of 1916, were you, and December, 1914?

A. Yes, I did not leave the plant until along in September, 1915.

Q. 9. Do you know whether the figures and results set forth here are accurately stated?

A. I think they are reasonably accurate.

Q. 10. Well, by "reasonably"—within what limits do you mean?

A. Well, insofar as it is possible for—

Q. 11. (Interrupting) You mean that they are as accurate as it is possible to make them: is that what you mean?

A. Well, I would say that, yes.

Q. 12. This is the exhibit from which we struck three or four lines on account of Mr. Wicks not having been connected with the plant during the first part of 1915, and if counsel has no objection I would like to substitute this inasmuch as Mr. Weiser has testified to the accuracy of this first part.

MR. GARRISON: I intend to interpose an objection based on the same ground as interposed with respect to the testimony of Mr. Wicks, as to the competency and relevancy of the testimony to be given by this witness. Personally, I have no objection if Mr. Williams thinks of none, for the course to be pursued by Mr. Scott with respect to that exhibit if your honor

accepts it, but I desire to have the objection recorded before your honor rules upon the method of introducing the proof. After the objection is ruled on—

MR. KREMER: I am going to suggest, in view of the fact that there will be a number of witnesses of this same character, it might be considered that the objection is interposed instead of constant repetition of it.

THE COURT: Was there an objection to this originally?

MR. GARRISON: I don't know whether there was an objection specifically to this sheet. I gather that your honor had—

THE COURT: You object to all of this variety of testimony?

MR. GARRISON: Yes, sir, and I thought that it was not necessary to encumber the record by constant repetition, and object to the details unless the detail was objectionable.

THE COURT: The court must have overruled it then.

MR. GARRISON: I imagine so.

THE COURT: I will overrule it now.

MR. GARRISON: Your honor at this time understands the same as I, when I once object to the whole line of testimony from a witness, there is no necessity to renew it.

THE COURT: No, it will cover all of that.

MR. GARRISON: That is, if we had a specific objection it would cover that. My previous objection

Oba Wiser.

does not go to the offer of Mr. Scott based upon this witness. I have no objection to substituting one sheet for the other. With that understanding, Mr. Wicks' testimony only goes to so much of the sheet as is contained after the date of his employment, and that this gentleman's testimony goes to the portion before that, we have no objection to the sheet being put in, with the understanding that it is divided as to these dates.

THE COURT: Leave the old one in and put a new one in.

EXAMINATION ON VOIR DIRE.

BY MR. GARRISON:

Q. 13. Now, Mr. Wiser, do your duties enjoin upon you to have knowledge with respect to the various matters that are set forth upon that sheet?

A. Yes, sir.

Q. 14. And have you such knowledge of your own, derived from attendance at the mill, that enables you to say that so far as you know, the various figures on this sheet are accurate and correct representations of actions which took place?

A. Yes, sir.

Q. 15. Of your own personal knowledge?

A. Yes, sir, of my own personal knowledge.

Q. 16. So that if we should cross-examine you with respect to this you would not be in a position of saying that "as to that, I don't know that; that is something somebody else knows"?

A. Yes, sir.

Oba Wiser.

Q. 17. You will be able to answer the questions?

A. I think so.

MR. GARRISON: We have no objection then, on the matter of form.

MR. KREMER: We offer it and ask that it be marked the next number.

The sheet was admitted in evidence and marked DEFENDANT'S EXHIBIT 29.

DIRECT EXAMINATION CONTINUED.

BY MR. SCOTT:

Q. 18. Mr. Wiser, will you explain the items of this table down to the second quarter of 1915; just explain what the items mean, the first column entitled "Flotation Headings," with three subheads under.

A. Take these up just as they appear on the sheet, Mr. Scott?

Q. 19. Yes, please.

A. December 8 to 31 represents the period when we began the retreatment of vanner concentrate.

Q. 20. Two thousand three, the first item there, is the total?

A. Two thousand three tons were treated during that period, an average daily tonnage of 105. Per cent copper in the headings, 13.19; flotation concentrates produced, 588; per cent copper, 42.87—

THE COURT: What is the witness doing? Simply reading off this table that has already been introduced?

MR. KREMER: Supplements by a statement of the operations.

Oba Wiser.

THE COURT: I don't see any necessity of reading this off in detail. They are in evidence. If a question is to be based on it, proceed.

Q. 21. Were you in daily charge of these flotation operations?

A. Yes, sir.

Q. 22. And the operations set forth upon this sheet were carried out under your supervision?

A. Yes, sir.

Q. 23. I hand you defendant's exhibit 28. That is the tabulated statement of the treatment of slime vanner tailings, and ask you if you were present and directly in supervision of the operations there represented throughout the period stated?

A. With the exception of the two vacations I mention.

Q. 24. Your connection and supervision covered the period beginning with April 16, 1915?

A. Yes.

MR. SCOTT: That was an item that was not proved by Mr. Wicks.

EXAMINATION ~~ON~~ VOIR~~E~~ DIRE.

BY MR. GARRISON:

Q. 25. Now, Mr. Wiser, your personal knowledge with respect to these entries appearing on defendant's exhibit 28, is such that you can personally answer questions with respect to the verity of these figures; is that correct?

A. Yes, sir.

Oba Wiser.

CROSS-EXAMINATION.

BY MR. WILLIAMS:

X-Q. 26. I note that this last sheet now marked defendant's exhibit 28, that it contains your signature; how does it happen that exhibit 28 is signed by you, and exhibit 29 is signed by Mr. Wicks?

A. Mr. Wicks, I believe, had that report prepared and therefore signed it. This report I prepared myself or had prepared and I think I signed this after Mr. Wicks had left our plant.

X-Q. 27. So that the report signed by you was prepared by you?

A. Well, I had supervision of the preparation of it.

X-Q. 28. Whose business is it, or whose duty is it, in the ordinary course of business, to sign reports of this kind?

A. Well, there never has been any definite understanding as to who signs these reports. Both the metallurgical engineer and the assistant superintendent sign reports of the same character.

X-Q. 29. When did the Chino Copper Company commence to treat slime vanner tailings in their regular operations?

A. In their regular operations, the first slime vanner tailings we treated was the treatment began on April 16, 1915. I will say that for the first three or four months the operations were more of an experimental nature than they were regular operations.

X-Q. 30. Did the plant run continuously?

Oba Wiser.

A. Well, it was running continuously for the date set forth in that summary. The other days—

Q. 31. (Interrupting) The interims are just shut-downs for alterations, I suppose?

A. For alterations.

X-Q. 32. So that this report covers the whole period of the treatment of slime vanner tailings in the Chino plant?

A. Yes, sir, it covers all operations for that product.

X-Q. 33. And that is equally true as to the other report, exhibit 29, which commences December 8, 1914; that covers all the treatment—retreatments of that product, vanner concentrate, in the Chino plant?

A. Yes, sir; it covers everything.

X-Q. 34. When you started in December 8th, 1914, what machines did you have; what flotation machines?

A. We had the Janney flotation machine.

X-Q. 35. Same general type of machine or same machines that you have now?

A. About the same thing that we have now.

X-Q. 33. Of course these original machines did not have any porous medium covered chambers for the introduction of air, did they?

A. You are referring now to the machine we use in the retreatment of concentrates are you not?

X-Q. 37. I am referring to the machine that has been called the Janney Mechanical Air Machine.

A. In the retreatment plant we are using the Janney Mechanical machine exclusively.

X-Q. 38. That is, retreating what?

A. Vanner concentrates.

X-Q. 39. It is only in the slime vanner tailings plant that you use these machines that have the air supplement? Is that right?

A. Yes, sir.

X-Q. 40. So these Janney machines installed December 8, 1914, were substantially the same as the machines that Mr. Wicks has described?

A. Substantially the same, having a Spitzkasten on one side only.

X-Q. 41. Then on April 16, 1915, when you started to treat the slime vanner tailings, what machines did you install?

A. That was the mechanical.

X-Q. 42. Just the mechanical machine?

A. With the double Spitzkasten, with a Spitzkasten on each side.

X-Q. 43. And when did you first put in machines with the compressed air supplement in the Spitzkasten?

A. I think that was during the period represented by July 13 to July 23d on this sheet, I am not positive, but I think that period covers the first installation of that type, with the air cells.

X-Q. 44. These air cells, have they double Spitzkasten or single Spitzkasten?

A. Well, there is an air cell in each Spitzkasten.

X-Q. 45. But are they double Spitzkasten machines, or single Spitzkasten machines?

Oba Wiser.

A. Double.

X-Q. 46. Double?

A. Yes, sir.

X-Q. 47. Now, in this slime vanner tailings plant, how many of the machines had the compressed air addition?

A. Well, all of them that we term rougher cells have this in.

X-Q. 48. All the rougher cells?

A. Yes, sir.

X-Q. 49. But the cleaner cells they don't have that?

A. The cleaner cells, the first two rows of machines on our pyramid type of cleaner are the mechanical machine, but the two lower rows have the air cells in them. They are all double Spitzkasten.

X-Q. 50. Do the lower machines that have the compressed air, do they make a finished concentrate?

A. Most generally. Sometimes we might circulate that product, but not very often.

X-Q. 51. That is to say, if the operation of the machines, your examination should show that it was not as good as it ought to be, you would send it back?

A. Well, sometimes it has been the custom to do that.

X-Q. 52. But that is not the general custom?

A. Not the general practice.

X-Q. 53. You haven't got with you, have you, a flow sheet of the mill or of the flotation plant?

A. I haven't, Mr. Williams.

MR. WILLIAMS: With the reservation that was made with regard to the other witness in view of the total lack of application of his testimony, I would like to reserve the right at a future time to continue the cross examination.

MR. SCOTT: That is all.

WITNESS EXCUSED.

THOMAS A. JANNEY, a witness called on behalf of the defendant being first duly sworn, testified as follows:

DIRECT EXAMINATION,

BY MR. SCOTT:

Q. 1. What is your full name?

A. Thomas Addison Janney.

Q. 2. And what is your occupation?

A. Superintendent of the Arthur plant of the Utah Copper Company.

Q. ~~5.~~3 At Garfield, Utah?

A. Garfield, Utah.

Q. 4. And what are your duties in that position?

A. I am in full charge of the operations of the plant.

Q. 5. And that plant is made up of a flotation department is it, and gravity concentration?

A. It is.

Thomas A. Janney.

Q. 6. How long have you held that position. Mr. Janney?

A. Since June 1, 1915.

Q. 7. And before June 1, 191~~6~~5, what was your occupation?

A. I was a metallurgical engineer.

Q. 8. Of the same plant?

A. Of the same plant.

Q. 9. And for how long a period were you metallurgical engineer?

A. I believe it was July 11, 1911, when I was made metallurgical engineer of the plant.

Q. 10. And, as metallurgical engineer did you have anything to do with flotation?

A. I had full charge of the flotation work.

Q. 11. The practical work and the laboratory investigation, both?

A. Both.

Q. 12. In these flotation operations, what was the nature of your first work in the laboratory?

A. Our first work in the laboratory was made for the cleaning of the low grade concentrates, which were produced by the vanner in the mill, and we worked on it in a general way trying to find a suitable oil for raising the grade of the concentrate.

Q. 13. Did your investigation extend over a long period?

A. It did.

Q. 14. For how long a period did the investiga-

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tion continue before any actual, full, scale operations were attempted?

A. I believe our experiments started in the early part of 1913, and we started commercial operations in February of 1914.

Q. 15. About a year of investigation?

A. Yes, sir.

Q. 16. In a general way, was it necessary to carry on such a protracted investigation?

A. I will correct that statement; it was the year 1915, some two years before we first started actual operations.

Q. 17. Two years of investigation in the laboratory?

A. Yes, sir.

Q. 18. I asked you why it was that so much investigation was necessary.

A. When we first started in we knew nothing about the flotation process.

Q. 19. Was the literature of the art and the product accessible to you?

A. Yes.

Q. 20. You had that assistance in your first investigation?

A. I think that I did read some patents, but they were of no assistance that I could see.

Q. 21. When you started first the flotation in the plant upon a practical scale, what amount of oil did you use in a general way?

MR. GARRISON: I suppose this is as good a time

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as any to interpose the objection for the reasons given in the objection to the testimony of Mr. Wicks.

THE COURT: Objection overruled.

Plaintiff excepted.

A. Well, our oil varied from a pound and a fraction up to 80 pounds when our experiment first started.

Q. 22. By experiments do you mean operations in the mill or in the laboratory?

A. That was in the laboratory.

Q. 23. But during the first part of your mill operations what was the quantity of oil, state it generally?

MR. GARRISON: Now, your honor, I think we are entitled to have the defendant indicate to us what part of the prior art the testimony of this witness will be devoted to and with respect to which the testimony of this witness is offered.

THE COURT: What is the object of this, Mr. Scott?

MR. SCOTT: The operations of the Utah Copper Company comprise the steps that are set forth in the Everson patent, the Kirby patent, the Froment patent, and the California Journal of Technology. As to the quantity of oil, the range of oil used by the Utah Copper Company has been both more and less than that indicated in the California Journal of Technology. The agitation, the grinding of the ore, its mixture with water, the addition of the oil, the agitation, the frothing, each step is represented in the various prior art documents. If it will be of any assist-

ance or serve any other purpose than delay, I would analyze all these patents for Mr. Garrison's benefit. I don't think it is necessary or profitable to do that at this time.

THE COURT: This case, of course, is being tried virtually the same as though the Hyde case never existed. Certainly the Hyde case was brought after this time, and we understand of course that it is the state of the prior art at the time the complainant's patent prevailed which is in question. Under the statement of Mr. Scott I think he is proceeding fairly. The objection is overruled.

Plaintiff excepted.

A. We used in the neighborhood of from two to eight pounds.

Q. 24. That was for what period of time?

A. That covers a period from 1915 up to and inclusive of December 21st, 1916.

Q. 25. Is the memorandum or table that you are consulting something that was prepared under your direction?

A. It was prepared under my direction, yes.

Q. 26. You have knowledge of its accuracy, have you?

A. Not to every figure, but I have no reason to believe that they are not accurate.

Q. 27. They were prepared under your supervision, and they are figures which you rely upon in your business, are they?

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A. Absolutely.

Q. 28. To that extent you can testify to the accuracy of the figures here set forth?

A. I can.

MR. SCOTT: I offer this tabulation in evidence at this time for the convenience of all parties, as the testimony will be based on it.

MR. GARRISON: A word of cross examination before it is admitted.

THE COURT: Yes.

BY MR. GARRISON:

Q. 29. Mr. Janney, is your relationship toward the various things set forth on this paper such that of your own knowledge you can disclose to us the source of the information and the accuracy of the results as tabulated upon this sheet?

A. I might explain that during the year 1915 I was not at the plant, but I have been there the balance of the time.

Q. 30. Then with respect to all of 1915 you have no personal knowledge?

A. I have no personal knowledge, except that I know the results are correct.

MR. GARRISON: We object to the introduction of this document which has records for ever month in 1915.

MR. SCOTT: Yes. I will offer it subject to further proof.

Q. 31. Who was in charge at that time?

A. My brother, Frank G. Janney.

MR. SCOTT: I offer it provisionally, subject to proof by Mr. Frank G. Janney.

BY MR. GARRISON:

Q. 32. With respect to everything that appears on this sheet headed "Utah Copper Company, Arthur plant, February 1st, 1915, to April 8th, 1917, inclusive," is the fact of your personal knowledge with respect to the operations of this plant such that you can testify as to the sources of these figures and their accurate representation of the truth?

A. I can except for a few days in the month of May, 1916, and a few days in October and November, when I was away from the plant.

Q. 32½. Then, otherwise, when you would be present, you have information in regard to these operations which would enable you to answer the questions concerning the results and the accuracy of these representations?

A. I am.

MR. GARRISON: I have no objection to the form, except the objection that I stated.

THE COURT: It will be admitted and it may be used by the witness to the extent of what he says he has knowledge of.

Tabulation presented by Mr. Janney marked DEFENDANT'S EXHIBIT 30, and admitted in evidence.

Thomas A. Janney.

BY MR. SCOTT:

MR. SCOTT: As far as the mere explanation of the table goes, I presume I may ask for the witness' comments on it, that is, its meaning and significance.

Q. 33. I notice the first column is headed "estimated tons treated." State in a general way how you estimate that tonnage?

A. Our plant is so arranged that during the time mentioned, from February 1915, up to and inclusive of December 1st, 1916, that we could not take a tonnage sample of the material treated, but from our assays we calculated the amount of concentrate produced. At the Magna plant of the Utah Copper Company, they took tonnage samples of the concentrate treated in flotation, and they compared that with the tonnage treated in the large mill proper, and inasmuch as the flow sheet of the mills are practically the same, we used their factor in order to determine the tonnage for the months mentioned.

Q. 34. Now, I notice that the upper part of this table, beginning February, 1915, and extending to December 21st, 1916, the amounts of oil range below six pounds; in the part of the table below, covering the period from December 22nd to April 8th, I notice two oil columns, one headed "new" and the other headed "circulating." I would like to have you explain the meaning of the circulation oil items, if necessary explaining the layout of the plant first, to make it clear?

A. Up to and including July 11th, 1916, we had one flotation plant in operation for the treatment of our low

grade concentrates, consisting of two emulsifier cells and thirteen frothing cells; from July 12th, 1916, to April 8th, 1917, inclusive we had two plants in operation for treating the same material. The second plant is composed of two emulsifiers and fifteen cells. The low grade concentrates, which concentrate we feed to these plants, is the overflow from the mineral classifier, which classifies the low grade concentrates produced by the vanners in the mill; which overflow is removed to two forty-four foot Dorr thickeners. The overflow from the Dorr thickeners is sent to waste; that is, it is not returned in the circuit, and the thickened product is divided and sent in approximately equal proportions to the two flotation plants. The feed going to our old plant runs by gravity from the Dorr tank, but the feed going to the new plant is pumped, due to a difference in the elevation of the plant and the Dorr tank. The pulp from the Dorr tank enters first the emulsifier, where oil is added, and then goes to the second emulsifier, thence to the first cell of the series of frothing cells. A high grade concentrate is made by the first few cells, and the balance of the concentrate produced is returned through our retreatment plant, thence back to the Dorr thickener.

Q. 35. Returned to what?

A. To the mechanical treatment plant where the vanner concentrate is classified. The flotation plants are so arranged that the middling will return to the mechanical treatment plant, and is elevated to the classifier and the overflow is then returned to the

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Dorr thickeners, as previously explained, in that way the middling is kept in circulation.

Q. 36. And the thickened product goes where?

A. It goes back to the head of the flotation machine.

Q. 37. And that is what you call the circulating load, is it?

A. Yes, sir; it joins the original feed when it enters the classifier. The concentrate made by the first few cells is sent to a Portland filter and the tailings are rejected.

Q. 38. Now, the question that I started out with was this heading of the table "New oil" and "circulating oil." Will the explanation of the machine so far given enable you to explain about the circulating oil?

A. I think so.

Q. 39. Suppose you tell us about that?

A. The concentrate which goes from the lower cells, which I spoke of as the middling, is sampled, and the quantity of the middling is determined by tonnage samples, and from this sample we determine the amount of oil which was in the flotation middling. Now, this column "new oil" is the amount of oil added for each ton of new feed entering the flotation machine.

Q. 40. That is, excluding the middling?

A. Yes, excluding the middling.

Q. 41. So much per ton of absolutely new material?

A. Yes, sir. The figures under the circulating

oil column are the figures which we credit as new oil. Now, we get that credit in this way: we figure that each ton of middling should carry twenty pounds of oil per ton, and all the oil in excess of that we credit as new oil and we credit that to our new tonnage.

Q. 42. That is why you have this tonnage column in which you have added up the new oil and the circulating oil.

A. Yes, sir.

Q. 43. What would you do in the event the middling would not carry its own share of the oil—that is carry less than twenty pounds?

A. Then we would have to add more new oil to make up the deficiency.

Q. 44. More than that necessary for the original feed, you mean?

A. Yes, sir. That is, we try at all times to have twenty pounds of oil per ton of material in the machine.

Q. 45. Whether the oil goes there with the middlings or is original oil?

A. Yes, sir.

Q. 46. Will you make a comparison from a metallurgical viewpoint of the results prior to December 22nd, and those beginning on December 22nd and extending to date?

A. From the time we started the plant, and up to and inclusive of December 21st, we rejected tailings from the flotation plant which assayed .361 per cent copper, and produced a concentrate that contained

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26.800 copper, and made a recovery of 96.57 per cent. During this period we used 3.76 pounds of oil per ton. Covering the period from December 22nd, 1916, to April 8th, 1917, we treated 63,176 tons of material, and rejected a tailing that assayed .238 per cent copper, and produced a concentrate containing 22.180 per cent copper, and made a recovery of 96.60 per cent, using 21.98 pounds of oil per ton.

Q. 47. Which operation represents the most profit—that is, which class of operation?

A. Well, the method which I will designate as the twenty pound method. When we used 3.76 pounds of oil per ton we rejected a tailing that contained 7.22 pounds of copper per ton, and with the method using 20 pounds of oil, or what I have designated as the twenty pound oil method, we rejected a tailing which only contained 4.76 pounds of copper per ton, which shows an additional saving of 2.46 pounds of copper.

Q. 48. Taking into consideration other factors would the large amount of oil show a greater profit?

A. It would.

Q. 49. Mr. Janney, the figures given for copper, iron, insolubles, tailings, etc., are percentages, are they not, all through?

A. Yes, sir.

Q. 50. I see the per cent indication is omitted from the copy that I have, but all these figures are percentages, are they not?

A. Yes, sir.

Q. 51. In the answer you have just given you applied

those percentages to a ton of 2000 pounds and made your calculation that way?

A. Yes, sir.

Q. 52. During this period from December 22nd to April 8th for which you have monthly averages, can you state whether large amounts of oil—considerably larger than are shown in the average—were used on any individual days?

A. From April 1st to April 8th we were making some special experiments, and during that time we used very small quantities and very large quantities. That is why the tailing assay is much higher than during the previous months.

Q. 53. You mean on account of the fact that you were performing experiments?

A. Yes, you see here I used a very small quantity of oil in this case, and the tailings are very high, and those results are included in this average.

Q. 54. Have you the statement of those experiments?

A. Yes, sir.

Q. 55. Were these experiments performed by you personally or under your personal direction?

A. Under my personal direction.

MR. WILLIAMS: Where were these experiments performed and when?

MR. SCOTT: If you will be patient, Mr. Williams, I will ask him.

MR. WILLIAMS: I object to testimony about experiments, which can so easily and readily be performed in court, as secondary.

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MR. SCOTT: If you will wait a minute, he will calm you.

Q. 56. Where were these experiments done, and in what kind of plant?

A. In the same plant that I have just testified to.

Q. 57. That is the full sized flotation plant of the Utah Copper Company?

A. Yes, sir.

MR. WILLIAMS: Will you give us access to that plant for examination when we wish it?

MR. SCOTT: Certainly, to where these experiments were performed and these runs.

MR. WILLIAMS: And the other one of which he has testified?

MR. SCOTT: We will let you see what pertains to this case and the flotation matters he has testified about.

MR. WILLIAMS: The objection will be withdrawn.

Q. 58. MR. SCOTT: Are the results set forth in this statement which you have in your hand correct to your knowledge?

A. They are.

MR. SCOTT: I offer a copy of the statement in evidence to which the witness is referring.

Table admitted in evidence and marked DEFENDANT'S EXHIBIT No. 31.

Q. 59. Now, Mr. Janney, I think I will let you explain in your own way the purpose of these experiments and what you did, but before starting in I wish to ask

you as to the character of the apparatus and the scale of the operation and what was done with the concentrates?

A. In these experiments I had to take all the feed that was going to the flotation plant, and that was controlled by the amount of ore treated in our mill, and the concentrates produced were sent to the smelter as in all cases with our concentrates, and the tailings were rejected. The plant that I performed these experiments in was the regular plant used for cleaning the concentrates, and no alterations or changes were made in any respect.

Q. 60. Were any changes made in the mode of operation of the plant?

A. None whatsoever. We tried to operate the plant to get the best results we could in each case. There were a few conditions varied probably in the dilutions of the pulp, but that was done to accomplish the best results we could. On the day shift of March 30th—

Q. 61. The dates do not appear here, do they?

A. I noticed last night that the dates were not there but I will testify as to the dates.

Q. 62. They are all numbered in a serial order from one to thirteen?

A. Yes, sir.

Q. 63. Were these things done on succeeding days?

A. No. Whenever an experiment would come to my mind that I would like to perform, I carried it out.

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Q. 64. Well, then, if you refer to them by dates you better tell us what number it is here so we will know.

MR. WILLIAMS: Go down consecutively.

A. I will go down consecutively. Experiment No. 1 covered a period of eight hours on the day shift of March 30th. We treated 151 tons of dry feed. We used 1.6 pounds of oil per ton of new feed and we credited to our new feed 6.31 pounds of oil which was contained in the circulating feed.

Q. 65. Before we go on: Was that 6.31 in the circulating feed on the basis of the 20 pounds as you explained a moment ago?

A. No, sir

Q. 66. In that event, you haven't added the oil in the circulating load?

A. We determine the total oils—we determined the total amount of oils in the circulating load and considered that amount as new oil. There was no reason to credit 20 pounds of oil to these experiments because we were trying to get a certain number of pounds of oil per ton. The total oil used per ton of new feed was 7.91 pounds and the total pounds of oil per ton of total feed which includes the circulating feed with the initial feed was 6.87 pounds.

Q. 67. So that the column "per ton total feed" represents, takes into consideration all the oil, does it and all of the solids, does it, whether circulating or not?

A. Yes, sir. During that period the tailings rejected contained 1.577 copper and the concentrates pro-

duced contained 18.325 per cent copper, and the indicated extraction was 71.07. I might mention that the oils used for these experiments from 1 to 13 inclusive was a mixture of oil composed of 59 per cent smelter fuel oil. It is an oil that comes from California which the smelter at Garfield uses as fuel oil and thirty per cent of Jones oil which is a topped petroleum oil and comes from Oklahoma. By a "topped oil" I mean an oil that has had the gasoline and kerosene removed; and ten per cent American Creosote No. 2 which is a coal tar derivative, and one per cent Yaryan pine, which is a steam distilled pine oil.

Q. 68. Steam distilled?

A. Yes, sir, it is not destructively distilled. Would you like me to testify to all of these results?

Q. 69. I would like you to make a comparison, briefly, of the different experiments in the first tabulation, as to the amount of oil and as to the tailings and grade of concentrates, and the indicated extraction?

A. Experiment No. 6 was made on the 25th of March, duration of the test was twenty-four hours.

MR. WILLIAMS: What number was that, 6?

A. No. 6. The total oil used for that test was 20.97 pounds per ton of total feed. The tailings rejected contained .141 per cent copper.

Q. 70. MR. SCOTT: How does that compare with the tailings in this first experiment, on the first days when you used six pounds and eight tenths of oil per ton?

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A. Was very much lower, very good results. I might mention that during that twenty-four hours we treated 627 tons of ore, initial ore.

Q. 71. Is there any general trend in the character of these results as the quantity of oil is varied?

A. The results improved as the quantity of oil was increased. In this particular test we made a 97.76 per cent recovery against 71.07 when we used 6.87 pounds per ton. The grade of concentrate was 24.50 per cent copper against 28.10.

Q. 72. No, you read the wrong figure, didn't you; didn't you read out of the "iron column" instead of the "copper" when you said 24.5?

A. It should read 18.692 per cent copper against 18.325 per cent copper. I will just take two or three experiments at random.

Q. 73. Suppose I put a question or two to you, Mr. Janney. I notice that the variation in the amounts of oil in these thirteen experiments is from 6.87 pounds to 96.46 pounds and that the increase in the different runs has been made in fairly regular increments. Now, can't you give us a brief statement as to the effect of that increase in oil upon the tailings and the concentrates and the extraction, as an entirety without reading the individual figures in all cases?

A. As the oil was increased in these experiments the result—the tailings rather were lower and the grade of the concentrates remained practically the same and the recovery increased. That is up to experiment No. 7

where we used 25.50 pounds of oil per ton, total tonnage. And the results were even comparable down to where we used 59.39 pounds of oil per ton of total feed. In that case the tailings contained 1.66 per cent copper and the concentrate contained 17.099 per cent copper, and the recovery was 97.26 per cent. Our tonnage was 572 tons per twenty-four hours.

Q. 74. Was there any falling off in the character of the results as you get to the extreme quantity of oil, 96 pounds?

A. The tailing was a little higher when we used 96.46 but still it was a commercial result, tailing contained .272 per cent copper and the concentrate was slightly lower.

Q. 75. Are the concentrates with that materially larger quantity of oil, 96, than in any other one of the experiments?

A. Well, the concentrate is practically the same you might say.

Q. 76. I notice they were lower with some of the smaller amounts of oil than with 96 pounds?

A. The concentrates throughout the whole test were practically the same. The difference is very small.

Q. 77. That is, speaking from a business standpoint, you would regard them just about the same, the concentrates?

A. Yes, sir, the concentrate in each case is commercial concentrate.

Q. 78. Now, what was the purpose of these experi-

ments in the last group, No. 14 to 19 entitled "using 91 per cent American creosote No. 2, and 9 per cent Yarvan pine"?

A. These tests were made to determine if it were the American creosote and pine oil that brought about these good results.

Q. 79. You mean independently, do you?

A. Yes, sir; that is to say, I wanted to determine if this smelter fuel and Jones oil played any part in the production of the good results.

WHEREUPON an adjournment was taken until 2:00 p. m., of this day, Thursday, April 19, 1917.

2.00 P. M., April 19, 1917.

MR. JANNEY.

DIRECT EXAMINATION (Resumed).

BY MR. SCOTT:

Q. 80. Mr. Janney, I don't think I asked you the description of the material this low grade concentrate, which is the subject of these experiments with large quantities of oil—what that is, that low grade concentrate.

A. That is the overflow from the mineral classifier.

Q. 81. About what degree of fineness is it?

A. There is only 2% of the material that will

stay on a 65 mesh screen, having an opening of .0082 inches.

Q. 82. Have you any figures as to how much will pass through finer screens?

A. 36% will pass through a 200 mesh screen, having an opening of .0020 inches.

Q. 83. Will you state once more the object of these experiments, numbered from 9 to 14, in this summary of results of experiments on low grade concentrates?

A. The oil used in these experiments was a mixture made up of American creosote No. 2 and Yaryan pine oil, which was used with the smelter fuel, and Jones oil in the experiments from 1 to 13 inclusive. My object in using this oil in these experiments was to determine whether or not this oil alone was responsible for the high recovery made.

Q. 84. That is, whether the American creosote and Yaryan pine did the work or not? And so you used them alone to find out?

A. Yes, and I tried to use the amount that was used in certain experiments, numbered 1 to 13. Take, for example, experiment No. 14, in which I used .61 of a pound of oil composed of American creosote No. 2, and Yaryan pine; that would correspond to experiment No. 1; that is, .61 of a pound would approximate the amount of this oil mixture used in experiment No. 1.

Q. 85. Just explain that a little. In experiment No.

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1 the total oil was 1.39 pounds. Now what relation has this .61 to that?

A. The total used in experiment No. 1 was 6.87 of oil.

Q. 86. Oh, yes, 6.87. What relation has this .61 pounds in experiment 14, to 6.87 pounds in experiment 1?

A. In experiment 1 it will be noted that in the oil used there was 11% of oil composed of American creosote No. 2 and Yaryan pine, and 11% of 6.87 would be .76; so the experiment No. 14, in which I used .61 pounds of American creosote and Yaryan pine, would approximate that figure.

Q. 87. Explain why you did not get the exact amount in experiment 14 that would correspond to 11% of 6.87 pounds in experiment 1?

A. You can not tell exactly how much ore is going through the machine; and we have to calculate the amount as near as possible.

Q. 88. Now, if I understand you, that .61 pounds in experiment 14 of creosote and pine mixture, corresponds roughly to the amount of those same two oils in the mixture used in experiment 1

A. It comes very close.

Q. 89. That was the purpose of the experiment?

A. Yes, sir.

Q. 90. Now you may proceed and describe the relation between the others, if you wish to.

A. In experiment No. 14, in which I used .61 pounds

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of American creosote No. 2, and Yaryan pine oil, I treated 53 tons in two hours, and the tailings rejected contained 3.433% copper.

Q. 91. How does that compare with the tailings obtained when you used these same two oils with the addition of smelter fuel and Jones oil?

A. It was over twice as high.

Q. 92. Now you may compare the extraction.

A. The extraction made while using .61 creosote and Yaryan pine was 29.54%, while in experiment No. 1 the recovery made in that extraction was 71.07, showing that the recovery was more than twice as high.

Q. 93. When you used the mixture including all four of the oils?

A. Yes, sir.

Q. 94. Now, do these other experiments numbered from 5 to 19, correspond in quantity of creosote and pine, with the amount of those ingredients used in some of the experiments between 1 and 13?

A. Approximately, yes.

Q. 95. Indicate which ones correspond, or if you have a column which indicates that, just point it out and name it—I see a column here at the right which says: "Refer to Exp." Is that the column that indicates the corresponding experiment?

A. Yes, sir.

Q. 96. The numbers in the column as I have it—it has been corrected—are, reading from the top, 1, 3,

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4, 5, 6 and 8. Is that the corrected form, the proper form?

A. Yes, it is.

Q. 97. Now, just make a comparison between, say, experiment 19 and experiment 8 in the matter of efficiency of the two operations.

A. In experiment No. 8 the tailings rejected contained .251% copper, while in experiment No. 19 the copper contained in the tailings was 1.217%.

Q. 98. That is about four or five times as much?

A. That is about five times as much.

Q. 99. And how about the extraction in those two cases, Nos. 19 and 8?

A. In experiment No. 8 the extraction was 95.19, while in experiment No. 19 the extraction was 84.02%.

Q. 100. Something over 10% under?

A. Yes.

Q. 101. What is the purpose of the last experiment recorded here, No. 20, in which you used 60% of smelter fuel and 40% of Jones oil?

A. The object of that experiment was to determine whether this oil alone could produce any results.

Q. 162. Does that experiment at the bottom of the page No. 20, correspond in the amount of smelter fuel and Jones oil with any experiments between 1 and 13? I see you have 17.84 pounds of oil in No. 20. Does it compare with No. 6?

A. I think that is the closest one.

Q. 103. And how have you found out, by taking what per cent of the twenty—

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A. (Interrupting.) The object of running this test, Mr. Scott, was to determine if 20 pounds of this oil alone would bring about a commercial result.

Q. 104. Regardless of the comparison with the other?

A. There was no comparison between the two experiments.

Q. 105. And compare the results you thus obtained, using the fuel experiments, as to concentrate, tailings and extraction?

A. In that test I endeavored to use twenty pounds of oil, but we were off on our calculations and it only amounted to 17.84 but even though the oil was a little low it compared very favorably with the test in which I used other oil and fuel oil and Jones oil. Take for example No. 4, the tailings are practically the same although the oil is greater comparably. In one it was 14.53 pounds against 17.84.

Q. 106. But the 14.53 in experiment No. 4 is of the entire mixture, containing the four ingredients?

A. Yes, sir. Experiment No. 6, if we eliminate the American creosote and the Yaryan pine we would get approximately the same amount of oil that was used in experiment No. 24. In experiment No. 6 the tailings was fourteen hundred against the .306 in experiment No. 20.

Q. 107. Showing the entire mixture was more efficient than the smelter fuel and Jones oil alone?

A. Yes, sir. Smelter fuel and Jones oil lack froth-

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ing properties, properties to bring about the whole recovery.

Q. 108. And that is contributed by the other ingredients, the creosote and the Yaryan pine?

A. Yes, Yaryan pine and creosote is used to produce the bubbles or create the froth, although this froth produced in experiment No. 20 was identical, but with a little more frothing oil added to it I would get a much better result.

Q. 109. You mean identical in what, appearance?

A. Yes, sir. You had your air bubbles with the mineral attached to it.

Q. 110. Well, from this tabulation, exhibit 31 that we are considering, would it appear that the smelter fuel and the Jones oil contributed more to the result than the American creosote and the Yaryan pine?

A. It would seem that the smelter fuel and the Jones oil contributed the most to the result because 95.09 recovery was made by its use alone.

Q. 111. Compare that with the recovery which was made in experiment 13 where you used 96. 46 pounds of oil per ton you find what?

A. In experiment 13 where we used 96.46 pounds of oil per ton of feed the recovery was 95.39 per cent; while in the case of experiment No. 20 the recovery was 95.06.

Q. 112. And how about the comparison between the copper in the tailings.

A. Experiment No. 13 the copper in the tailings was

.272; while in experiment No. 20 the copper in the tailings was .306.

Q. 113. This morning, in discussing the method of figuring tonnages, you stated that a factor had been established at the other mill, the Magna mill which you used in the Arthur mill. Are you certain that that is the method of calculating tonnage at the Arthur mill?

A. After leaving the court room I began to think about it and I was not sure as to whether that factor was established at the Magna mill or whether we had established it at the Arthur plant after we started taking the tonnage samples.

Q. 114. But in either event there is a factor established and that you used as a basic of calculations?

A. Yes, sir.

Q. 115. Is there any peculiarity about the ore of the Utah Copper Company, which you are accustomed to handle at the Arthur mill and Magna mill?

A. In one particular, regarding flotation. I have found that our ore is much more difficult to treat when it is freshly crushed than it is after it has been allowed to stand in water for several days. The age of the ore in the presence of water seems to make it much more amenable to treatment than when it is freshly crushed.

Q. 116. Well, in actual practice, how long has the ore been crushed and subject to moisture before it does reach your flotation department?

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A. It would be just the matter of a few hours.

Q. 117. Long enough to assist any in the flotation operation?

A. I think not.

Q. 118. You think it could be handled better if the time interval was lengthened?

A. Yes, sir. I know it to be a fact.

Q. 119. Have you operated the Arthur plant or any part thereof upon slime feed with varying quantities of oil and in a manner similar to that you have just described with reference to the low grade concentrate?

A. I have.

Q. 120. This work was done by yourself personally or under your supervision, was it?

A. Under my supervision.

Q. 121. Have you recorded the result?

A. I did not record the results myself, but I had them tabulated.

Q. 122. You have a record of that with you?

A. Yes, sir.

Q. 123. Similar to the copies I have?

A. Yes, sir.

Q. 124. You know of your personal knowledge, do you, that this record is a correct record of what was done?

A. Yes, sir.

Q. 125. And it is so correct?

A. Yes, sir.

MR. SCOTT: I presume there is no objection at all other than the original objection to this exhibit?

MR. WILLIAMS: It is understood that the objection, having been stated, need not be repeated every time.

THE COURT: The record will so show.

Record of operations of Arthur plant admitted in evidence and marked DEFENDANT'S EXHIBIT 32.

Q. 126. MR. SCOTT: This tabulation which has been received in evidence as exhibit 32 is entitled: "Summary of results obtained from commercial experiments on slime feed." Will you please explain what this slime feed is?

A. Why, the ore, as it comes from the mine, is in sizes ranging from two feet square, approximately, and we reduce it in our coarse crushing plant to approximately three quarters of an inch and it is fed to our fine bins where it is recrushed in ball mills in our flotation section. The product from the ball mill goes over what we call a Garfield roughing table where the coarse mineral is removed. The tailings are elevated to a classifier—I might mention it is a hydraulic classifier—and the coarse sands are returned to Chilean mills and ~~b~~all mills for regrinding. The overflow from the classifier goes to a 75 foot Dorr tank and the sand products of the classifier which are fine enough for concentration are treated on a vanner. The tailings from the vanner are sent to waste and the concentrate is sent to our retreatment plant.

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Q. 127. That is the plant you have just described?

A. That is the plant I have just described. And the thickened product from the Dorr tank constitutes our flotation slime feed.

Q. 128. About what degree of fineness is this?

A. Approximately 75 per cent will pass through a 200 mesh screen.

Q. 129. That is regarded as very fine slime, is it?

A. Yes, sir.

Q. 130. Did that present any difficulty in the way of flotation treatment other than the difficulties encountered in treating the low grade concentrate?

A. We had a great deal of trouble in working out a process for the treatment of this slime. Our experiment started, I believe, in the early part of 1913 in the laboratory and in the latter part of 1914 we built a slime plant at the Magna plant of the Utah Copper Company, and at that time I had charge of the operation.

Q. 131. Well, during that period what amount of oil were you using—about a year, wasn't it, you named in the investigation?

A. We used various amounts of oil. In 1914 the oil we used was in the neighborhood of one to five pounds.

Q. 132. Per ton?

A. Per ton, if my memory serves me correctly, we were not able to get any kind of a result there

that would be consistent. One day we would get a low tailing and the next day our tailing would be high, and it was not until April, 1915, that we finally were able to treat our slime successfully.

Q. 133. 1915, that was, wasn't it?

A. It was 1915, I think it was. And then at that time we discovered a combination of oils and acid that gave us good results. Previous to April of 1915—no, it was April of 1916. I was not at the plant in 1915—April, 1916. We had tried all kinds of creosote oil, pine oils, petroleum oils and almost every oil that we could get a hold of. We tried in combination with these oils certain alkalies, tried it in a neutral state and also in the presence of acid; and in April 1916, we discovered that by sulphinating a creosote oil and pine oil in the proportion of 95 per cent Barrett oil, which is a creosote oil, and five per cent pine oil and the use of acid we could get excellent results.

Q. 134. Have you since discovered any other combination of oils that are as efficient as this particular one that you have described?

A. Recently we have discovered that by using a large quantity of certain oils we can get very good results.

Q. 135. Is that the limit of the different ways you get at it—this particular oil that you have just mentioned—that kind of oil that you say you have used lately?

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A. Yes. Well, in July, 1915, on the 30th of the month, and previous to this time we had found some oils that would give us very good results, but we could not operate on account of the expense.

Q. 136. What caused the expense?

A. The large amount of oil required, and we had to use a certain oil, a special oil which we sulphinated, and we also had to use an alkaline solution.

Q. 137. How much of that oil did you have to use?

A. We used all the way from—I think it is two pounds up to 27.42.

Q. 138. And which amount gave the best results?

A. We had to use a large amount of oil.

Q. 139. I don't know just what you mean by a large amount.

A. Well, around 13 pounds.

Q. 140. Now, referring to this tabulation, exhibit 32, relating to the slime treated, is the oil mixture recorded upon that sheet the same as that which you used in your large amount of oil experiments on the low grade concentrate?

A. It is not the same oil.

Q. 141. You did not find the same oil applicable to both kinds of material?

A. No, sir.

Q. 142. What was the purpose of these experiments numbered from 21 to 29?

A. I had found from laboratory tests, using large quantities of oil, and I wanted to verify my results on a larger scale of operation, and that was the purpose of these experiments.

Q. 143. Did these large scale operations of the mill coincide with what you had concluded from your laboratory work?

A. Yes, sir.

Q. 144. Will you give a statement of the effect you found from increasing the amount of oil in these successive experiments from 21 to 29?

A. I found that after we got above 56 pounds of oil per ton the results were practically the same.

Q. 145. The concentrates in the last three there, 27, 28 and 29, where the amount of oil was 56 pounds or above, were what in copper?

A. Experiment No. 27, in which we used 56.99 pounds of oil per ton, the concentrate assayed 16.400% copper. In experiment No. 28, where I used 78.40 pounds of oil per ton, the copper in the concentrate was 14.30. In experiment No. 29 where I used 99.43 pounds of oil per ton, the concentrate assayed 15% copper.

Q. 146. Now how did the tailings vary with the increase of oil from experiment 21 to 29?

A. Their copper content lowered as the amount of oil was increased, with the exception of one day.

Q. 147. And that was which one?

A. That was experiment No. 22.

Q. 148. I see in experiment 22 the tailing went up; that is, with the smaller amount of oil in experiment 21,

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the tailing was .18, and in experiment 22, with 11.36 pounds, the tailing went up to .475, and that after that there seems to be a general decrease in the tailings with the increase of the oil. Can you explain that irregularity in any way?

A. There are certain conditions that may arise in the plant—

Q. 149. You don't know the precise condition, do you?

A. No, I don't.

Q. 150. But with that exception, the increase of oil seems to accompany a decrease in the tailing, does it not?

A. Yes, sir.

Q. 151. At the bottom of this sheet, exhibit 32, there are 4 experiments recorded, as 30 to 33 inclusive. Will you state the purpose of those, and how they served that purpose?

A. In experiment 21 to 29 I used a mixture of oil composed of a mixture made up of 60% No. 34 degree paraffine base distillate, and 40% of gilsonite, and another mixture composed of 95% Barrett No. 4 creosote and 5% Yaryan pine. These two mixtures were combined in the proportion of 98 and 2% respectively.

Q. 152. As indicated at the head of the sheet?

A. Yes, and in experiments No. 30 to 33 inclusive, I used a mixture of oil composed of 95% Barrett No. 4 creosote and 5% Yaryan pine oil.

Q. 153. Corresponding with the second ingredient of the mixture used above?

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A. Yes. My object in running these experiments, 30 to 33 inclusive, was to determine whether or not this particular mixture of Barrett No. 4 creosote and Yaryan pine was responsible for the high recovery made.

Q. 154. And what did you find out from these experiments?

A. I found that the amount of Barrett creosote and Yaryan pine oil used in experiment 21 to 29 inclusive was not responsible for the high degree of recovery.

Q. 155. As a matter of fact how do the recoveries compare?

A. Well, they are not comparable at all.

Q. 156. These recoveries are correctly stated here, are they, 9.88% and .69%, and 16.40% and 1.33%?

A. Yes.

Q. 157. That is practically nothing in the way of a recovery is it?

A. I would not consider it a good recovery. Those oils were used in that mixture merely as frothing agents.

Q. 158. Can you state what your conception is of a frothing agent as determined—as distinguished from an oil that is not a frothing agent?

A. I have run across a great number of oils that in themselves do not possess the properties of creating froth when they are agitated, but they have a quality or property of selecting the mineral from the gangue. Then there is another class of oils which I call frothing agents, which are capable of producing froth, and making the air bubbles stable.

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Q. 159. But do they necessarily gather up the mineral?

A. Well, these particular oils themselves have a slight selective action, but the degree of recovery is very low.

Q. 160. As here in experiment 32?

A. Yes, sir, the Barrett creosote and Yaryan pine.

Q. 161. Those are frothing agents?

A. Yes.

Q. 162. And in that particular instance, did they seem to do much besides contribute the frothing quality?

A. They did not, or they would have made a higher recovery.

Q. 163. How many oils or mixtures of oils do you know that will be operative in flotation of this slime feed of the Utah Copper Company?

A. There are two oils—two mixtures of oils, rather, that can be operated on a commercial scale, economically.

Q. 164. Are those the ones you have mentioned, the sulphinated oils?

A. The sulphinated oils and the gilsonite mixture.

Q. 165. That you have actually used?

A. Yes.

Q. 166. Do you know of any other oils that are operative?

A. No, I do not.

Q. 167. How many different oils do you suppose you have tried and investigated in your search for an operative oil?

A. I think we have in our laboratory some thousand oils.

Q. 168. Have you tried them both alone and in mixture?

A. Yes, sir.

Q. 169. And these two combinations are all that you have discovered?

A. That is all.

Q. 170. Have you ever had any difficulty in getting oil in sufficient amounts for the purpose of running your plant with over 1% of oil?

A. We would be operating our slime plant now, if we were able to get oil in sufficient quantities to keep it going.

Q. 171. About how much oil would it take per day to keep it going, in rough figures?

A. It would take about 10,000 gallons a day to keep our present plant in operation.

Q. 172. How many tank cars would that be?

A. That would be one tank car. That is just for our slime plant, however.

Q. 173. For the Arthur plant?

A. For the Arthur plant alone.

Q. 174. And the Magna plant is about the same size?

A. Well, that is just for the slime treatment, and it would take about 1500 gallons per day for the retreatment plant, and the Magna plant would take about the same amount.

Q. 175. Can you form any estimate as to the amount

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of oil it would take if you were to use flotation to its fullest extent in the Arthur and Magna mills?

A. It would take 87,500 gallons of oil per day.

Q. 176. And how much reserve oil is it necessary to carry?

A. We should carry at least 60 days' oil on hand, to protect ourselves against any unforseen difficulties that might arise.

Q. 177. Was there any other occasion besides those days in July, 1915, upon which you used a large amount of oil—a comparatively large amount—previous to your present operations, I mean.

A. What do you mean by a large amount of oil?

Q. 178. Above ten pounds.

A. I believe during the months of June, July, August and September, the amount of oil we used per ton was near 13 pounds.

Q. 179. What year?

A. 1915.

BY MR. GARRISON:

Q. 180. I thought you were not there that year.

A. I was not.

MR. GARRISON: I move that that testimony be stricken out. He was not there.

THE COURT: I think that portion of his testimony should be stricken.

Q. 181. What can you state as to the comparative occurrence of these froths with small and large amounts of oil?

A. There is practically no difference, except in the

case where we used an extremely large amount of oil, such as a hundred pounds, the froth looked a little more oily.

Q. 182. What can you say as to the efficiency of the results with the same amount of oil in the laboratory operations as compared with operations in the mill?

A. Why, our mill operations have always checked, or even were better than our laboratory experiments.

Q. 183. When you increased the amount of oil to 20 pounds recently, did you make any changes in the plant or in the operation of the machinery?

A. None whatsoever.

Q. 184. You mean that you simply turned on more oil?

A. We had to prepare a means for taking a tonnage sample, but that did not change the flotation plant itself. The machines were not touched, or any of the conditions varied whatsoever.

Q. 185. Now, have you any information as to the amount of oil that goes off with the concentrates and with the tailings, do you know as to what becomes of the oil generally, when you are using these amounts above 20 pounds per ton?

A. In the retreatment of our low grade concentrate, I found that approximately 92% of the oil rejected from the plant was contained in the concentrates, and about 8% in the tailings.

Q. 186. Did you make determinations as to the amount of oil that the middlings had or returned to the head of the machine?

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A. Yes, sir.

Q. 187. Have you any figures or recollection as to what they carried?

A. I have. When we are operating with about 20 pounds of oil per ton I found about 60 pounds of oil per ton is in the middlings.

Q. 188. That, to the ton, the middlings carry 60 pounds of oil?

A. That is what I was trying to say, yes. In the case where we used 36.45 pounds of oil per ton for the total feed, our concentrate on that particular day, contained 111.18 pounds per ton of concentrate, and the tailings contained 8.20 pounds of oil per ton for the tailings, and the middlings contained 36.75 pounds per ton for the middlings. Of course the amount of oil in the middlings varies with the mode of operation.

Q. 189. Now, the return of that middling carrying 36 pounds of oil per ton—I will omit the fraction—has what effect on the oil supply at the head of the machine when you are attempting to supply 1% of oil to the solids being treated?

A. In this particular case where there is 36 pounds per ton of the middlings, we credit to the total oil used, 12 pounds, and that multiplied by the tonnage of middlings would be the total amount of oil that would be credited as new oil.

Q. 190. Twelve pounds, would you say?

A. Well, the middling takes 36 pounds per ton, and it would take 20 pounds of that to satisfy the mid-

dling—Oh, I beg your pardon; I should have said 16 pounds.

Q. 191. You mean that 16 pounds would be credited as new oil?

A. 16 pounds would be credited as new oil, and in order to get the total amount of oil that we would credit, we would have to multiply that by the tonnage of middlings.

CROSS EXAMINATION

BY MR. WILLIAMS:

X-Q. 192. That figure that you gave of 60 pounds of oil to the ton of middlings, where did you get that from?

A. That was just one particular day that I happened to pick. We had a test on March 6th where we used 20 pounds of oil per ton of the total feed, and our middlings contained 47.29 pounds. If you want to take time for me to look through my record I can pick out that day. Here is another case where we used 20 pounds, and we got 42 pounds per ton for the middlings.

X-Q. 192½. That 60 pounds was rather an exaggeration, wasn't it, or a slip?

A. No; here is a case right here—I was looking over my record last night—where we used 24 pounds, and we got 64 pounds in the middlings.

X-Q. 193. Let me look at those figures—Now the entry that you have shown me reads "Pounds of Oil in

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Circulation, 4434, or 64.26 pounds per ton of circulating feed." What is the basis of that determination?

A. We take tonnage samples to determine what our circulating feed amounts to, and in this particular case it amounted to 69 tons. We analyzed that and found that it contained 64.26 pounds per ton of that feed. 64.26 multiplied by 69 should give 4434.

X-Q. 194. And what was the total—then it is a calculation, isn't it, of the total amount of material flowing into that circulating feed?

A. Certainly. We could not take the whole 69 tons and determine the amount of oil in it. We would have to rely on our analysis for that.

X-Q. 195. What happened to that 64.24 pounds per ton?

A. It went down through our return plant and back to the Dorr tanks.

X-Q. 196. And then what happened to it?

A. Then went through the flotation machine.

X-Q. 197. Were you building up all the time in that flotation machine an added increment of oil from that circulating feed?

A. The way we operated our plant, we take what concentrates look clean enough, and would send that directly to the smelter or to the bins rather and the concentrate coming off the balance of the machine we considered middlings, and that constituted our circulating feed.

X-Q. 198. Well, if you were returning such an amount of oil you would be building up in your machine a great quantity of oil, wouldn't you?

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A. Not necessarily, because about the second time the oil goes through the machine it would be going out in the form of a concentrate or with the tailings.

X-Q. 199. And this would be just something that happened at a certain minute and could not be maintained?

A. No, sir, that would become constant. The tonnage samples were taken every half hour and a composite sample~~s~~ ~~were~~ was taken from that sample for the twenty-four hours.

X-Q. 200. Now, what figures have you there that shows where that oil went to after it went through that machine?

A. I have no figures in this particular case. It must have gone out in the tailings or in the concentrate.

X-Q. 201. When was this experiment performed?

A. That was not an experiment; that was an actual operation.

X-Q. 202. When was it done?

A. In March, 1917.

X-Q. 203. Of what year?

A. Of 1917.

X-Q. 204. What were the oils that you were using or the mixture of oils?

A. A combination of smelter fuel oil and American creosote combined in proportion of 90 per cent smelter fuel and 10 per cent American creosote No. 2.

X-Q. 205. You might read the description of the flow sheet in the record; read it.

A. During that day seven cells, the concentrates

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from seven cells was sent to the bins and the products from 21 cells were in circulation. The tailings were sent to waste. Now speaking of 7 cells and 21 cells, that is the total number of cells in both of our plants. One machine has 13 cells, and the other has 15, making a total of 28 cells.

X-Q. 206. What machine was this in?

A. This is the composite result from both machines—this is treating low grade concentrate.

X-Q. 207. The same natural division between the two machines and an average of what was going on in the two machines; is that it?

A. Yes, sir.

X-Q. 208. I ask you to read into the record the description of that days proceeding—of, if counsel will consent—the stenographer can copy it into the record and then give it back to you.

MR. WILLIAMS: We will ask the stenographer to copy both days as they appear on the sheet.

The sheet above referred to, which was used by both counsel and the witness is as follows:

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March 13	Toppage.	Cu.	Fe.	Insol.
Heading	414.0	4.900	6.97	77.07
Tailing	315.0	.248		
Concentrate	99.0	19.685	25.36	17.36
Per Cent Indicated Extraction				96.15
Ratio of Concentration				4.18
Per Cent Solids in Feed				29.56

Total Tonnage New Feed	414
Total Tonnage Circulating Feed	69
Total Tonnage Feed Entering Machine	483

Oils and Reagents Used

Pounds New Oil Added	7,186, or 17.36 lbs. per ton New Feed
Pounds Oil in Circulation	4,434, or 64.26 lbs. per ton Circ. Feed
Lbs. Oil Required for Circ. Tonnage	1,380, or 20.00 lbs. per ton Circ. Feed
Pounds Circ. Oil used as New Oil	3,054, or 7.37 lbs. per ton New Feed
TOTAL LBS. OIL USED AS NEW OIL	10,240, or 24.73 lbs. per ton New Feed
Pounds Calura Reagents Used	3,266, or 7.89 lbs. per ton New Feed

Oil Combinations: 90% Smelter Fuel, 10% American Creosote No. 2
Flow Sheet: 7 cells to bins; 21 cells to circulation, tailing to waste
No. 1 machine down 6′35″. No. 2 machine down 5′05″ due to broken table line shaft in Retreatment Plant.

March 14	Toppage.	Cu.	Fe.	Insol.
Heading	666.0	5.450	7.33	78.33
Failing	519.0	.315		
Concentrate	147.0	23.585	23.42	18.82
Per Cent Indicated Extraction				95.50
Ratio of Concentration				4.53
Per Cent Solids in Feed				32.12

Total Tonnage New Feed	666
Total Tonnage Circulating Feed	68
Total Tonnage Feed Entering Machine	734

Oils and Reagents Used

Pounds New Oil Added	10,467, or 15.72 lbs. per ton New Feed
Pounds Oil in Circulation	4,250, or 62.50 lbs. per ton Circ. Feed
Pounds Oil Required for Circulating Tonnage	1,360, or 20.00 lbs. per ton Circ. Feed
Pounds Circ. Oil used as New Oil	2,890, or 4.34 lbs. per ton New Feed
Pounds Calura Reagents Used	3,985, or 5.98 lbs. per ton New Feed

Oil Combinations: 90% Smelter Fuel, 10% American Creosote No. 2
Flow Sheet: 8 cells to bins, 21 cells to circulation, tailing to waste.

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X-Q. 209. These machines in all of these plants you have described are known as Janney machines, are they not?

A. They are.

X-Q. 210. You are the inventor of these machines, are you not?

A. Yes, sir.

X-Q. 211. I now show you patent No. 1,167,076 to Thomas A. Janney, patented January 4, 1916, for ore concentrating apparatus, application filed August 10, 1914. You are the Thomas A. Janney to whom that patent was issued?

A. Yes, sir.

X-Q. 212. I now show you patent No. 1,201,053 patented on October 10th, 1916, to Thomas A. Janney, for ore concentrating apparatus, application filed April 23rd, 1914. Are you the Thomas A. Janney to whom that patent was issued?

A. I am.

MR. WILLIAMS: I offer these patents in evidence.

MR. KREMER: I object to them for the reason that they are incompetent, irrelevant and immaterial for any purpose unless it is to show a picture or cut of the apparatus. The contents of the patent has nothing to do with the matter in issue. A photograph of the machine might be admissible.

MR. WILLIAMS: I would like to state the purpose.

THE COURT: What purpose, other, will that serve, Mr. Williams? What have you in mind?

MR. WILLIAMS: They serve the very important

purpose of showing that all of these operations that have been described at such length by this witness and are said to represent the prior art have been carried on in a modern machine invented by Mr. Janney long after the art of flotation concentration became a part of the knowledge of the world by reason of the patent in suit.

MR. KREMER: There has been no proof that that was the cause of the result. The cause of the result, as the witness has testified, is the use of a certain oil upon a certain ore, and was not the method in which the work was carried on. I started to say, "experiment" but it was not an experiment it was an operation. It has nothing on earth to do with it.

THE COURT: That is your claim. Now they have a right to make their claim.

MR. KREMER: If they desire to introduce that as a part of their defense, we will admit it.

THE COURT: They have a right to offer it on cross examination. The objection will be overruled.

MR. KREMER: Exception.

Patents admitted in evidence and marked PLAINTIFFS EXHIBITS 33 and 34.

X-Q. 213. MR. WILLIAMS: Generally, the first of these patents, #1,167,076, is for the large sized commercial machine, as you made it originally, is that right?

A. Yes, sir.

X-Q. 214. And the second issued ~~of the~~ patent—

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A. That was the first patent.

X-Q. 215. No. 1,201,053 on which the application was first filed?

A. Yes, sir.

X-Q. 216. That is your test machine, is it not?

A. Yes, sir.

X-Q. 217. Now, generally, when did you first put at work in a practical operation, the machine of the large size shown in your first issue of patent, generally; about when?

A. I think it was in July of 1914—or I think it was in the early part of 1914.

X-Q. 218. The early part of the year 1914?

A. Yes, sir.

X-Q. 219. And as to your other patent on which the application was first filed, when did you get that apparatus first working?

A. That was in the latter part of 1913.

X-Q. 220. Then, there is another type of machine which has been testified about, your machine with a pneumatic arrangement, compressed air going through a coarse medium in the Spitzkasten, that I take it is a later product, isn't it, later improvement?

A. I developed that machine, I think it was in the year—put it in actual operation in the latter part of 1914 in a sort of an experimental way. We put it in actual operation at the Chino Copper Company the first time, if I remember right, for large scale operations, I believe it was in June or July of 1915.

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X-Q. 221. That was just after the Wilmington trial, was it not?

A. Yes, sir.

X-Q. 222. You haven't any earlier patent on machines, flotation machines, than those two that have been put in evidence, have you?

A. No, I have not.

X-Q. 223. In fact, you never invented—you haven't any other in actual issue of patents, have you?

A. No, sir.

X-Q. 224. And these patents are your first inventions in flotation machines?

A. They are.

X-Q. 225. Now, in respect to the experiments in defendant's exhibit 31, series of results obtained from commercial experiments on low grade concentrate, you testified to given dates when the experiments were carried on, and you gave only one or two. I will ask you to state them in series?

A. Experiment No. 1 was made on the day shift of March 30th, 1917. No. 2 on March 29th. That ran twenty-four hours. Experiment No. 3 was on the 28th of March. No. 4 was on the 27th. No. 5 on the 26th. No. 6 was on the 25th. No. 7 was on the 28th. No. 8 was on the afternoon and night shift of March 30th. Experiment No. 9 was made on April 1st, 1917. Experiment No. 10 was made on March 31st, on the afternoon and night shift. No. 11 was run on April 2nd. No. 12 was

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on April 14th. No. 13 on April 3rd. No. 14 on April 6th. No. 15 on April 5th. No. 16 on April 5th—I am not sure. I will have to look it up to see whether it was on the day shift or the afternoon. And No. 17 was on the day shift of April 5th. No. 18 was on the afternoon shift of April 8th, and No. 19 was also on the afternoon shift of April 8th.

X-Q. 226. They were successive experiments—any space in between?

A. No, sir.

X-Q. 227. Couldn't have been?

A. No, sir.

X-Q. 228. Now, No. 20?

A. No. 20 was on April 7th.

X-Q. 229. 1917?

A. 1917, yes, sir.

X-Q. 230. How many experiments of the character of those described on April 20th, of the same general character, that is using those oils, sixty per cent smelter fuel and forty per cent Jones oil, did you carry on?

A. Why, at the Arthur plant that is all we carried on, but at the Magna plant they carried it on for several days I believe.

X-Q. 231. You have not made any showing of this experiment on the—what is it, the Magna plant?

A. Magna plant. No, just testifying to the Arthur plant results. That is all this tabulation covers.

X-Q. 232. Now, I note that on experiment 31

your circulating oil is undetermined or was not given under experiments 14, 15, 16 and 17. Why is that?

A. On those days we, unfortunately, got mixed up in the samples that were taken. My instructions were not carried out and I did not know it until several days after the test was made.

X-Q. 233. Your samples got mixed so that you could not be sure of the results?

A. The boy did not take the right samples.

X-Q. 234. Now, in taking the circulating oil samples for experiments 18 and 19, how did you make your computation for those soluble constituents of the oils that had gone into solution?

A. The way we determine the amount of oil in these samples was this way: A sample was taken in the wet shape and was dried over a steam bath, and we tried not to dry off—and we tried not to drive off any of the lighter oils, and as far as our knowledge goes none of the oils were driven off by the steam bath, as the temperature couldn't very well get over 100 degrees C. A portion of the sample was then taken and placed in a flask that had previously been weighed. We added to this sample some petroleum ether and placed a stopper or cork in the flask with the stem of the reflux—that—

X-Q. 235. That is to say, an apparatus in which the material is evaporated and goes up and then condenses and goes back to where it started from?

A. Yes, sir. This flask was placed on a hot plate and allowed to boil for some time until we

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thought all the oil was in solution. Then we took that sample and decanted all of the filtrate off and then rewashed the sample until we were sure that all of the oil had been extracted and was filtered. We then took the filtrate and placed it under another condenser and then we drove off all of the petroleum ether by means of the heat derived from a steam bath. That is, we tried to keep our temperature under 100 C. And we continued heating at this temperature until all of the petroleum ether had been driven off. The flask was again weighed and the difference in the weights was considered the amount of oil in the sample. We went through the same routine on that same sample with benzoil. We did that because we found that petroleum ether would not dissolve the coal tar oils, and then later we washed it again with alcohol in the same manner; and the sum of the residues from each determination was added together to determine the total oil.

X-Q. 236. Well, your American creosote No. 2 contained something else besides oil, didn't it?

A. Not to my knowledge. It contains napthalene, is all, a little fraction of coal tar.

X-Q. 237. How about phenols?

A. I presume there are some phenols in it.

X-Q. 238. Isn't there usually a large proportion of phenols, a very substantial proportion of them in creosote? Can't you tell me about this creosote, what proportion of phenol ~~and what proportion of phenol~~ and what proportion of oils, insoluble?

A. We do not determine them as phenols. We determine our oils as tar acids. Now, I am not chemist enough to know just what those tar acids are.

X-Q. 239. Well, give me your determination?

A. Tar acid value of the American Creosote No. 2 was 4.4 per cent.

X-Q. 240. Now, did you make any determination of the solubility or soluble parts in the proportion used?

A. No, we have not.

X-Q. 241. As a matter of fact, you know that phenol and cresol are soluble frothing agents?

A. I have heard they are.

X-Q. 242. Have you ever tried them?

A. No, sir; not in a pure state I haven't.

X-Q. 243. Don't you know whether they are or not?

A. I saw you people use them in Wilmington, in the Wilmington case.

X-Q. 244. Well, you saw us use them then?

A. Yes.

X-Q. 245. As soluble frothing agents and producing froth in that trial, didn't you?

A. Yes, sir.

X-Q. 246. Now, as to these soluble frothing agents that were present in that American creosote why, your determination does not tell us anything about that, what became of that, what proportion of that appeared in the circulating load?

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A. We didn't make our determination to try to find out what particular oils were returned in the middlings. We were just trying to find how much oil, regardless of the kind.

X-Q. 247. Well, these would not come within your determination of oils, would they, these substances, phenol and cresol?

A. I don't think they would evaporate with the water. I think the boiling point of phenol and cresol is a little lighter than that of water.

X-Q. 248. Well, but did you take a great bulk specimen of the water so that you would keep all the phenol and cresol that was circulating in it?

A. Yes, sir, that was taken in a bucket so we would get everything.

X-Q. 249. So you rather think the phenol and cresol in your operations were determined in weighing oils?

A. I do.

X-Q. 250. Now, in your plant how did you handle the water, did you use it over again?

A. Not the water that has been through our flotation plant, we don't.

X-Q. 251. The water that goes off with the tailings of the flotation plant, does that ever get back again?

A. Well, I presume it does. It goes out in a large field. I don't know how large it is, but it looks to me like it was a couple of miles square—and the water is returned, or a portion of it is returned.

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X-Q. 252. Well, then, you do use the same water over again?

A. Not at our plant. It goes to both plants. We have one central pumping station.

X-Q. 253. Well then, the water from the two plants goes to this great lake or pond and there you settle out the solids and then that is pumped back and used over again, is that right?

A. Yes, sir, but the amount of oil in proportion to the amount of water we use at both plants, I doubt very much whether you could find a trace of oil in the water.

A. X-Q. 254. That is to say there is so much water that comes from the plant that has not been through the flotation plant, is that the reason?

A. Yes, sir.

X-Q. 255. So that even now, with these large quantities of oil, you think there would not be a trace of oil worth speaking of in the water?

A. I doubt whether a chemical analysis would detect it.

X-Q. 256. You never have made any determinations?

A. No, sir. We treat in both plants between thirty and forty thousand tons of ore a day, and for every ton of ore that goes through the plant we use one gallon per minute per ton of ore per day, so that would be 1440 gallons per ton of ore per day. 1440 times 40,000 would make quite a bit of water.

X-Q. 257. In your table, defendants' exhibit 31,

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you have "reagents, total pounds" in one column and "pounds per ton" in another column. What are those reagents?

A. It is an alkaline reagent.

X-Q. 258. Such as?

A. I can tell you just exactly what Dr. Ebaugh, chemist of the University of Utah says it is. It is made by boiling a mixture of lime, sulphur and caustic soda together, and Dr. Ebaugh says that—mixtures—that it forms a compound of no one definite mixture, but is composed of calcium, thiosulphate, calcium sulphide or polysulphide in solution and also sodium sulphide and the thiosulphates.

X-Q. 259. Do you use that most of the time?

A. Yes, sir, we used that entirely in the treatment of our low grade concentrates.

X-Q. 260. And that is the whole of the "other reagents"?

A. Yes, sir. At times we have used as a frothing agent a mixture of sodium sulphide and rosin.

X-Q. 261. And would that be in other reagents? Would that be in the "other reagents" column?

A. No, we didn't use that during these tests.

X-Q. 262. So that in these tests, you used these—you used this peculiar substance that was made out of—

A. Yes, sir.

(Whereupon a short recess was taken.)

X-Q. 263. I think you want to make a little correction.

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A. Before recess I mentioned that Dr. Ebaugh was at the University of Utah, but I think now he is doing private consulting work in Salt Lake City.

X-Q. 264. Now, let us take experiment No. 1 on defendant's exhibit 31. The amount of the oil that was fed into the machine was 1.6 pounds to the ton of solids in the feed. Is that right?

A. 1.6 pounds of oil for every ton that went into the machine.

X-Q. 265. That is, you fed into the machine 1.6 pounds of oil for every ton of solids that was fed into the machine at the entrance end?

A. Yes, sir.

X-Q. 266. And then this next figure, 1.39 pounds per ton, that is figured on what?

A. On the original feed, plus the circulating feed.

X-Q. 267. That would be the total amount of solids going through the machine from what point to what point?

A. From the emulsifier to the last cell.

X-Q. 268. And how many cells?

A. In one machine we have 13 and in the other one we have 15.

X-Q. 269. And how many emulsifiers?

A. Two emulsifiers at the head of each machine.

X-Q. 270. Then under the heading, "Total new and circulating oil," we have per ton of new feed, 7.91 pounds. How do you determine that?

A. That is determined by multiplying the 151 tons times 1.6; that would give you the total oil added to

the machine. Then our circulating tonnage was 23 tons, and that was multiplied by the analysis—that is, the amount of oil determined by analysis, in that circulating feed, by the circulating tonnage.

X-Q. 271. How was that determined.

A. That was determined just like I mentioned before recess.

X-Q. 272. From the total material, water and solids, or liquid and solids which was moving back in that circulating feed?

A. Yes.

X-Q. 273. Now, what was the proportion of oil on the concentrates that were delivered by that plant in that experiment?

A. I haven't that figure.

X-Q. 274. Was it measured?

A. Not the oil in the concentrate, no.

X-Q. 275. Did you measure the amount of oil in the tailings?

A. No, sir.

X-Q. 276. Then apparently with a feed of 1.6 pounds of oil to the ton of feed, you jumped in the plant to 6.87 pounds to the ton of solids flowing through the plant. Is that right?

A. Yes, to 6.87 pounds.

X-Q. 277. Do you regard the determination that you made of that as a reliable calculation?

A. Yes, sir.

X-Q. 278. But you can not tell us where that oil went to afterwards?

A. No, I can not.

X-Q. 279. At what time during the operation was that measurement taken?

A. That figure was calculated from a composite sample made up of samples taken every half hour during the day.

X-Q. 280. During the 8 hour run?

A. Yes, sir.

X-Q. 281. Did you make up a composite sample before you measured—Did you measure the individuals of that composite?

A. No, sir. We had a cutter—I think it had a half inch opening in it, and we passed it across the stream, and we would take the contents collected and put them in a bucket and let them accumulate for 8 hours.

X-Q. 282. Now, I was not able to understand your description of these plants. Have you any flow sheet or drawing that would help us to understand?

A. No, I have not.

X-Q. 283. You could supply a drawing that would represent the condition of these plants, couldn't you, by way of a general diagram, so as to make your description clear?

A. If you will get permission from Mr. R. C. Gemmell, the manager, of the plant, I will be glad to do so.

X-Q. 284. But you have described it?

A. Yes.

X-Q. 285. I would like to have you describe it by a picture.

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A. I haven't that authority.

X-Q. 286. Are you willing to draw the picture?

A. With permission from Mr. Gemmell, I am.

X-Q. 287. Did you get his permission to describe the plant in your testimony?

A. No, but I have received instructions that I am not to give out any flow sheets of our plant. If I drew you a plan of the mill, I would be disobeying my instructions.

X-Q. 288. I don't want the mill, I want the flotation plant that you have particularly described.

A. I think I can get that authority, to draw you that.

MR. SCOTT: Do you simply want a diagram of the flotation cells and the direction in which the pulp flows and where the middlings are returned and where some of it goes to the cleaner, or what?

MR. WILLIAMS: Just a pictorial representation of each of these plants so we can have a concrete representation of the plant.

X-Q. 289. BY MR. SCOTT: Is there any objection to making a sketch of the flotation cells with arrows showing which way the pulp flows, Mr. Janney?

A. I think not.

X-Q. 290. BY MR. WILLIAMS: Well, make that sketch of both plants, and then we can understand one from the other, just of these flotation plants; of course you have no such drawing now?

A. No, I haven't.

X-Q. 291. Now, will you supply specimens of the oils that you have described?

A. I will.

X-Q. 292. And also a specimen of your ore, reduced to quarter inch size?

A. I cannot give you a representative sample of our ore, because our mines cover some 720 acres of ground, and the steam shovels may be working in one part today and another part tomorrow. I can get you a sample, but I don't know that it would be representative of our ore.

X-Q. 293. Couldn't you get a sample representative of what you used in the experiment that you have described?

A. I can give you samples of our slime feed, but that is ground pretty fine.

X-Q. 294. You have those with you, haven't you?

A. I have some of that pulp with me, yes.

X-Q. 295. Well, let us have samples of your slime feed, and then try and procure from the mine a specimen as near as possible to what you used in your experiments, dry crushed to quarter inch size. Will you do that?

A. I will do that. Now, in giving you these oils, I don't know that I can give you the exact oil. When I left the plant the sample I took was taken from a tank containing some 14 or 15 thousand gallons of pine oil, and since then some oil has been put into it, and it may not be an exact duplication of the oil that I used. That holds true with respect to all other oils. I will give you what the manufacturers furnish as American creosote and Yaryan pine and so on.

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X-Q. 296. That is to say, if the manufacturers have varied the grade since you did these experiments, you won't be responsible for it; is that the idea?

A. That is the idea.

X-Q. 297. Well, that will do for that. Now, I don't know that I quite clearly understood—When you were making your oil determinations did you de-water your sample?

A. I did not; water and oil were taken down to dryness over a steam bath.

X-Q. 298. So that it was a determination of the whole amount of the material that was flowing?

A. Yes, sir.

X-Q. 299. Did you make any examination of the petrolic ether and the benzol that you used for the purpose of determining whether there was any non-volatile matter in that?

A. We purchased our petrolic ether and benzol from the Mine & Smelter Supply Co., of Salt Lake City, and they were purchased as chemically pure products.

X-Q. 300. After exhibit 31, on your exhibit 32 I see that there is no experiment corresponding to the last experiment on Exhibit 31. Why didn't you make that—

A. I don't quite understand you.

X-Q. 301. In exhibit 31 your last experiment was one in which you used those oils, smelter fuel and Jones oil alone, without any of the oils that you called frothing oils. In exhibit 32 there is no such experiment described; that is to say, you do not

separately take your paraffine distillate and Gilsonite and see what they would do alone. Did you make that experiment?

A. I have done it in the laboratory, but not in actual practice. I was pressed for time, and I did not have time to do that. It was fair to assume that if the creosote and Yaryan pine would not do it, but the mixture together would, that the Gilsonite mixture was evidently playing a very important part.

X-Q. 302. But you have not tried it on a large scale, and you don't know what would happen on a large scale as a basis of trial?

A. No, I do not.

X-Q. 303. When you described the material which you called slime feed, you said 75% would go through a 200-mesh screen, and you did not supply any other particulars of the screen analysis. Can you do so, and if so, will you?

A. Yes, I have a screen analysis here which I think is fairly representative. This screen analysis was taken for the month of January, 1917, of our flotation heading.

X-Q. 304. Just give it.

A. .12 of 1% of this material passed through a 28-mesh screen and remained on a 35-mesh screen. .5% passed through a 35-mesh screen and remained on a 48-mesh screen. .157% passed through a 48-mesh screen and remained on a 65-mesh screen. 5.94 passed through a 65-mesh and remained on a 100-

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mesh. 8.79 passed through a 100-mesh and remained on a 150-mesh. 7.63% passed through a 150-mesh and remained on a 200-mesh. 75.46% passed through a 200-mesh screen.

X-Q. 305. Now, give me the screen analysis of the low grade concentrate which you used.

A. .05 of 1% of this material passed through a 28-mesh screen and remained on a 35-mesh. .27 of 1% passed through a 35-mesh and remained on a 48-mesh. 1.97 passed through a 48-mesh and remained on a 65-mesh. 12.09% passed through a 65-mesh and remained on a 100-mesh. 21.93 passed through a hundred mesh and remained on a 150-mesh. 27.33 passed through a 150 mesh and remained on a 200-mesh screen. 36.36% passed through a 200-mesh screen.

X-Q. 306. And these screens were of what standard?

A. They were Tyler's Standard screen, in which the ratio of openings was 1.414. You can have these screens if you want them. There is one screen there that I have not testified to.

X-Q. 307. Which one is that?

A. The concentrates.

X-Q. 308. Give the screen analysis as you have of the other material.

A. This screen analysis that I have now is the concentrate produced from our slime plant. .08 of 1% passed through a 35-mesh screen and remained

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on a 48-mesh. .25% passed through a 48-mesh and remained on a 65-mesh. 1.57 passed through a 65 and remained on a 100-mesh. 4.20 passed through a 100 and remained on a 150-mesh. 4.61 passed through 150-mesh and remained on a 200-mesh. 89.29% passed through a 200-mesh.

X-Q. 309. BY MR. SCOTT: Is that the concentrates from the slime flotation treatment?

A. Yes, sir.

X-Q. 310. BY MR. WILLIAMS: What is this Gilsonite oil that you have mentioned?

A. Gilsonite itself is in a solid form. It is solid, hydro-carbon, which comes from the Uinta Valley in the northern part of Utah, I believe.

X-Q. 311. And it is the material as it is dug up out of the ground?

A. Yes.

X-Q. 312. What is its general nature?

A. It looks in appearance like asphaltum. This sample of Gilsonite that I analyzed or had analyzed, rather, was black in appearance, with a metallic lustre, very fragile. I subjected it to a distillation test and found that it contained 56.58% of oil by weight. The oil obtained from this distillation had a gravity of .8704. The color was deep red, and it becomes dark upon standing. The odor was very disagreeable; it had an odor of decomposition, with no sediment present, and very slightly viscous. The analysis showed that all the oil was distilled off at 350 degrees centigrade.

Thomas A. Janney.

X-Q. 3~~0~~13. What was the other material besides oil?

A. I don't know. After we distilled off all the oil, the residue looked like coke.

X-Q. 314. And it was distilled at what temperature?

A. The report shows that the maximum temperature was 350 degrees centigrade.

X-Q. 315. You would call the material tar, wouldn't you, that you had left after the distillation—the solid material that was mixed with the oil?

A. The cinder—it could not be like tar, because I said it was fragile, while tar is soft.

X-Q. 316. Was heat used in any of this work that you have described in the tables that have been put in evidence?

A. You mean the tables of the experiments?

X-Q. 317 Well, we will take first the experiments: was any heat used?

A. No.

X-Q. 318. Now, as to the operations extending over the period that you have knowledge of, was heat used at times or all the time?

A. Which table are you referring to?

X-Q. 319. Exhibit No. 30.

A. I haven't got these marked, so will you kindly read the heading?

X-Q. 320. "The Utah Copper Company, Arthur plant, February 1st, 1915, to April 8th, 1917." Now,

confine the question to what was done when you were there, in 1916, was heat used at any time, and if so, at what time?

A. I was at the plant in February 1915, and previous to that time, in the latter part of 1914, we had tried heat, but it did not help.

X-Q. 321. Why are those operations given as commencing in February, 1915?

A. That is when we actually started to operate flotation at the Arthur plant.

X-Q. 322. What was done with the material which this plant received before—with the material of the grade and character that this plant received, before this flotation plant was installed?

A. We shipped it to the smelter as a low grade concentrate.

X-Q. 323. Mixing it in with a high grade concentrate, I suppose?

A. We took part of it and mixed it in with the high grade concentrates. Our smelter contract is such that we are penalized if our insoluble exceeds our iron, and the concentrates as made by our finishing table, generally contained a higher percentage of iron than insoluble, and we would mix some of this low grade with it, so that the iron and insoluble would practically balance. The balance of the low grade concentrates we usually shipped to the smelter, as our high grade charge was limited to a certain figure, and we found it would be cheaper to smelt

Thomas A. Janney.

it separately than to have all of our concentrate penalized.

X-Q. 324. As a result of the treatment that you gave this material in the flotation plant, what happened in general as to the value?

A. It increased the value of it.

X-Q. 325. Very materially, did it not?

A. Yes. We would not be doing it if it did not.

X-Q. 326. Well, as far as your knowledge goes, after having tried the result of heat before these operations were started, heat was not used during these operations, is that right?

A. Yes.

X-Q. 327. And I presume sometimes your water is pretty cold?

A. It gets very cold in the winter time.

X-Q. 328. What did you do with the slimes before you adopted flotation?

A. We treated it on vanners.

X-Q. 329. The same character of slimes that are now treated by flotation?

A. Practically the same.

X-Q. 330. What—with what sort of recoveries, we will say, as compared with flotation, and shorten it up.

A. If I remember correctly, we made somewhere in the neighborhood of 54 or 55% recovery on the vanners.

Thomas A. Janney.

X-Q. 331. And by flotation you made what?

A. Well, we are not treating the same product.

X-Q. 332. How is the product different now?

A. The product differs now inasmuch as I believe our slime now is a little finer than it used to be.

X-Q. 333. And what sort of recoveries do you make?

A. Now?

X-Q. 334. Well, I don't know whether you are operating now; but in general, what have you made with flotation?

A. After we discovered that sulphinated oil mentioned, our recoveries ranged up to 90%.

X-Q. 335. Are you using that now, that sulphinated oil, at the present time?

A. Yes.

X-Q. 336. What amount of oil are you using in that operation?

A. It is in the neighborhood of 1.4 pounds per ton.

X-Q. 337. Does your ore contain any oxidized material?

A. About 2% of our copper is in the form of an oxide.

X-Q. 338. Do you recover that?

A. I think not.

X-Q. 339. In general, what is the nature of your ore?

A. Our ore is an altered silicious porphyry with the mineral finely disseminated throughout the mass.

X-Q. 340. And a fair average of the copper content?

Thomas A. Janney.

A. The average copper content of our ore body is 1.46%.

X-Q. 341. And what are the upper and lower limits of the material that you treat—that you mine and treat and mill?

A. It varies between 1 and 1.8 per cent. There have been times when the ore has been a little higher than that, but it won't average that.

X-Q. 342. In exhibit No. 30, there are no weights of the dry product as I understand it; why is that—that is, the Utah Copper Company, Arthur plant, operations from February 1st, 1915, to April 8th, 1917?

A. Probably when I asked for those tabulations I had no reason for asking for the tonnage of concentrates produced. That tonnage can easily be calculated, though.

X-Q. 343. Make a calculation of that, please and be ready to give it to me later on.

A. Of the total, or for each month separately?

X-Q. 344. Each month.

MR. SCOTT: A tabulation of that, if it can be simply calculated, why should the witness be called upon to do it? It shows on the face of the table.

X-Q. 345. Can that calculation be made from the material that is given in this table without any additional material whatsoever?

A. Absolutely.

X-Q. 346. I think we would like to have your calculations because it is a necessary supplement to the information that your table gives?

A. If Mr. Scott has no objection I will.

MR. SCOTT: I have no objection, if you want to be a calculator for Mr. Williams.

X-Q. 346½. MR. WILLIAMS: One other point about sulphuric acid. In any of these operations was sulphuric acid used?

A. In our slime plant.

X-Q. 347. In your slime plant?

A. Yes, sir.

X-Q. 348. Does that show in the table?

A. Yes, sir, I think it does. Yes, it shows when it was used.

MR. WILLIAMS: I believe Judge Garrison would like to ask a question.

MR. GARRISON: With your honor's permission, I would like to clear up one matter, that is in doubt in my mind.

CROSS-EXAMINATION.

BY MR. GARRISON:

X-Q. 349. Won't you take this sheet which has been admitted in evidence and marked defendant's exhibit 31—would you rather use your own—refer to the first experiment. The sheet shows that there were 151 dry tons, does it not?

A. Yes, sir.

X-Q. 350. And it shows that you used 1.60 oil per ton?

A. Yes, sir.

Thomas A. Janney.

X-Q. 351. Which makes a total of 242 total pounds of oil used?

A. Yes, that is new oil used per ton.

X-Q. 352. No, no, answer my question just as I put it. (Read the question please.)

A. That is what I am trying to explain to you.

MR. GARRISON: Just say I am wrong if I am wrong. Just read the question please.

A. No.

MR. GARRISON: Read the question please.

(Question read as follows: "Which makes a total of 242 total pounds of oil used?")

X-Q. 353. You say you took 151 dry tons, is that correct?

A. Yes.

X-Q. 354. And to that you put in the plant 1.60 pounds of oil?

A. Yes.

X-Q. 355. That makes a total of 242, does it not?

A. It should make it.

X-Q. 356. Well, does it?

A. I haven't checked up the figures. I don't know.

X-Q. 357. All right, then, take a pencil and check it. It doesn't make it quite; it makes 241.50. I am not going to trip you on that.

A. Well, if it was 241.50 we drop the five and call it 242.

X-Q. 358. It is 241.60 as a matter of fact. I am caring nothing about that. Now, did you at any time in that day's operation add any more oil than 1.60 per ton, reckoned on 151 tons?

Thomas A. Janney.

A. At any one minute or any one hour?

X-Q. 359. Read my question please.

(Question read as follows: "Now, did you at any time in that day's operation add any more oil than 1.60 per ton, reckoned on 151 tons?")

X-Q. 359½. MR. GARRISON: Isn't that question plain?

A. I can't answer that accurately.

X-Q. 360. Why not?

A. Because I do not know the rate of flow through the machine; it might have varied from hour to hour.

X-Q. 361. I am not asking you that, sir, I am asking you in the whole eight-hour run did you ever add to that 151 tons more than 1.60 pounds of oil?

A. Not of new oil.

X-Q. 362. Then there never could be in that plant on that day by reason of anything that you did any more than 1.60 times 151, could there?

A. Yes.

X-Q. 363. How would it get in there?

A. It would come back in the form of middlings.

X-Q. 364. But, my dear man, if you only put 2~~3~~41—

MR. KREMER: Let the witness answer the question.

MR. GARRISON: I am not quibbling with him.

MR. KREMER: We waived the formality of one counsel cross examining, without any question.

THE COURT: He is puzzled; he wants to clear it up.

MR. KREMER: Counsel should not be puzzled.

MR. GARRISON: The court has said that I may continue. I have no desire to argue with him.

X-Q. 365. Now, Mr. Witness, if you never put, during that whole more than 241 pounds or 242 pounds—let's take your own figures—of oil into the plant how did any more oil than that get in the plant?

A. Why, it could stay in there and keep in circulation.

X-Q. 366. Why, certainly it could. But how could any more than 242 pounds circulate?

A. I don't think more than 242 pounds was circulating.

X-Q. 367. Precisely. Then there was never more than 242 pounds of oil in that plant during this eight hours, was there?

A. Why, sure there was, the new oil plus the amount of oil circulating.

X-Q. 368. But if you never put more than 242 pounds in that how could more than 242 pounds circulate?

A. Because we are not rejecting the 1.6 pounds of oil in the tailings.

X-Q. 369. I don't care what you are rejecting and what you are keeping. If you didn't put more than 242 pounds in oil in your tank how could any more than that circulate, by circulation, rejection or any other thing.

THE COURT: Probably the witness does not understand you.

Thomas A. Janney.

MR. GARRISON: Will you honor put it to him so he can understand it. I don't want to argue it with him.

X-Q. 370. THE COURT: You think there is other oil than this 242 pounds, as I understand it?

X-Q. 371. MR. GARRISON: You had 151 tons total of dry ore, didn't you?

A. Yes, sir.

X-Q. 372. And you applied to that 1.60 of oil, didn't you, during the whole eight hours?

A. Yes.

X-Q. 373. And you never put any more oil in than 1.60 times 151, did you?

A. No, sir.

X-Q. 374. Well, then, the total amount of oil that ever got in that plant that day was 242 pounds, wasn't it?

A. Yes, sir.

X-Q. 375. Now then, how was it possible then for any more oil to circulate or be in there than 242 pounds?

A. There must have been more oil in circulation when we started this test.

X-Q. 376. Well, then, this whole table is perfectly illusionary and useless, isn't it?

A. No, because I show the total amount of oil that went through the machine.

X-Q. 377. But the total amount of oil that went to the machine according to this table is 1.60 on 151 tons, isn't it?

A. No, I said there was some oil in circulation before that was put into it.

Thomas A. Janney.

X-Q. 378. Well, then, this sheet is entirely illusionary?

A. I didn't say we only used 1.60 pounds to the ton. I say we used 6.87.

X-Q. 379. Isn't the whole purpose of this table to show the amount of oil you were using per ton?

A. Yes, sir.

X-Q. 380. Now, you said on one day when you used 151 you take your plant to make a test—

A. Yes, sir.

X-Q. 381. (Continuing)—and you ran your plant eight hours to make a test, didn't you?

A. Yes, sir.

X-Q. 382. And you put into your mill 151 tons, didn't you?

P. 2617, After L. 17, insert "x-Q. 383. You said you added 1.60 oil to that, didn't you? A. Yes, sir."

A. Yes, sir.

X-Q. 385. Now if there were other facts that you did not put down on this sheet before you began that whole experiment is illusionary, is it not?

A. No, sir.

X-Q. 386. I wish you would explain that to me?

A. Our feed, as it is taken from the classifier goes to the Dorr thickener and that feed includes our circu-

P. 2617, L. 29, insert "that they are large enough so that if you would analyze" after "sure"

... get more than the total oils shown here, which is 1,195 pounds.

X-Q. 387. Although you put only 242 pounds of oil in during that entire experiment, in some way or other 1,195 pounds got into that machine?

A. Well, that is probably what was in the Dorr tank.

X-Q. 388. Then the experiment is entirely illusionary so far as demonstrating anything about putting in 1.60 of oil in 151 tons of ore, isn't it?

A. There were 6.87 pounds of oil in it when it entered the machine.

MR. GARRISON: I insist on an answer to the question. Read the question.

(Question read as follows: "Then the experiment is entirely illusionary so far as demonstrating anything about putting in 1.60 of oil in 151 tons of ore, isn't it?")

A. I do not agree with you.

X-Q. 389. Well, but it is an entirely illusionary factor isn't it, that you don't know anything about?

A. I know that there is oil in circulation.

X-Q. 390. Do you know how much?

A. No, I don't. I cannot tell until after the test is completed.

X-Q. 391. Why not? Why couldn't you have told at the beginning of the test if you could have told at the end of the test or any period in the test?

MR. KREMER: Let the witness answer.

MR. GARRISON: All right.

A. I couldn't determine how much oil was in the machine until after the run was over, because as I said before our samples were taken every half hour until the test was completed.

Thomas A. Janney.

X-Q. 392. I understood you to say a while ago that you did not doubt that if you analyzed the water in circulation in your mill it would be found that it contained the percentage of oil that you put your finger on, something over six pounds to the ton, or some other figure. Is that correct or not?

A. You are talking about one thing, and I am talking about another. You are talking about our flotation plant now?

X-Q. 393. Yes.

A. And when I made that remark before we were talking ~~out~~ about our mill proper and these machines?

X-Q. 394. Are these mixed up with these exhibits you have made, or can we confine ourselves to this one sheet without mixing them up with something else?

A. If you talk about the same thing I do.

THE COURT: If there is any doubt about these things you are talking about you may ask questions that pertain to that sheet.

MR. GARRISON: Wasn't the purpose of this first experiment to demonstrate according to your operations what the result was of milling 151 dry tons with 1.60 of oil per ton added?

A. Not exactly 1.60 pounds per ton, but a small quantity of oil. And I could not determine how much oil it was going to be because I knew that there was some oil coming back in the form of middlings.

X-Q. 395. Well, now, just one moment. Do you mean some of the 1.60 coming back in the form of a middling or oil coming from some other place than the one—than the 1.60?

Thomas A. Janney.

A. We did not stop the plant to clear out the Dorr tanks before that test was made, and some oil was in that feed from the day before.

X-Q. 396. In the feed? Then this was not new feed?

A. No, the stuff that comes from the Dorr tank is new feed and middlings.

X-Q. 397. Now, when you started with your 151 dry tons was there any other feed in the plant?

A. That 151 dry tons is new feed.

X-Q. 398. Was there any other feed in the plant when you started with 151 dry tons of new feed, this particular 151 tons that you put down on this sheet?

A. Yes, sir.

X-Q. 399. Well, then that is illusionary here because you mixed that, what you did with this experiment with something that was left over from some other experiment? Isn't that correct?

A. That is correct.

X-Q. 400. Then this experiment—these experiments do not represent what they purport to represent, do they?

A. Yes, they do.

X-Q. 401. Well, now, can you explain that?

A. I explained that our low grade concentrate goes to the retreatment plant, mechanical retreatment plant where it is classified. The overflow from that product goes to two forty-four foot Dorr tanks—forty-four feet wide and I think they are twenty feet deep, and the cubical contents of these tanks is something enor-

mous—I don't know what it is—and it contains quite a bit of feed. And as we operate from day to day these tanks or these two tanks become contaminated or contain so much oil that is carried over from the day before. Now, when I started these tests I knew that there was some oil in the feed in the Dorr tanks. I did not know how much, and I was trying to find out what result we would get by using a small quantity of oil, and that is what I did. I used 1.6 pounds of new oil and 5.48 pounds of oil that was in the tank before the test started.

X-Q. 402. You mean that was there. You don't mean that you used that?

A. That was in the tank before the test started.

X-Q. 403. So that as far as this sheet is concerned, showing what came in there, or 1.60 of oil, it is utterly useless?

A. With 1.60 pounds of oil, yes.

X-Q. 404. It is utterly useless?

A. Yes.

X-Q. 405. And it is utterly useless as to every one of the figures as to any of the quantities or amounts under 1.60?

A. Yes, sir.

X-Q. 406. Because in each instance the amount of oil you actually were operating with was entirely different from the figure appearing in the column in which the first figure is, 1.60?

A. Yes, sir.

X-Q. 407. And when you made an experiment there

was no way of demonstrating the verity of it unless you knew what was in the Dorr tank before you began? Isn't that correct?

A. I could not tell how much oil I was going to use until afterwards.

X-Q. 408. Yes, and you could not tell about a great many other factors because of the remnants of the previous days' operations that had not been cleaned out? Isn't that true?

A. Yes.

MR. GARRISON: That is all.

MR. WILLIAMS: Subject to the reservation as to the other witness, the cross-examination of this witness is closed.

RE-DIRECT EXAMINATION.

BY MR. SCOTT:

R-Q. 409. Mr. Janney, referring to this column "pounds new oil added per ton new feed" the figures in that column, do they accurately represent the amount of new oil that was added for each ton of new feed?

A. They do.

R-Q. 410. And if there is any error in these figures and you—I won't say "error," but if these figures do not represent the amount of oil per ton of material in the apparatus are they under or over the amount per ton?

THE COURT: Is that the old oil, circulating oil?

MR. GARRISON: May we have the question read?

(Question read.)

Thomas A. Janney.

MR. GARRISON: That last question, is that an inquiry as to the new oil or old oil in the circulating feed?

MR. SCOTT: The question refers to oil generally, one of these figures are under statement or under or over the entire amount of oil including everything.

THE COURT: These figures, the figures of the new oil?

MR. SCOTT: Yes.

MR. GARRISON: I respectfully submit there cannot be an answer to the question, the witness having testified that they accurately represent the amount of new oil. How can they be under or over something else?

MR. SCOTT: Certainly.

MR. GARRISON: I cannot see.

THE COURT: One may be certain of his figures, yet he may be able to say if he is wrong he has underestimated instead of over estimated.

MR. GARRISON: I did not understand it was an estimate. I understood he said it was the exact amount.

THE COURT: I understood it so, yet it is an estimate for the whole day as the testimony all seems to show. He may answer.

A. These figures are obtained in this way. We weigh every bit of oil, new oil, that goes into our oil feeder, by actual weight, and a record is kept of that. And then we take tonnage samples to determine the tonnage of ore treated in the plant. The total oil by weight put into the plant per day is divided by the total

tons of new ore treated, which will give the pounds of oil per ton; and these figures are absolutely accurate as far as I know. I have not checked them but they should be absolutely accurate.

R-Q. 411. Now, in this computation here did you allow twenty pounds of oil per ton in the middling before crediting any of the middling oil to the new oil?

A. Not in that experiment.

R-Q. 412. Not in that experiment?

A. No, sir.

R-Q. 413. In these experiments here you could not allow the oil in the middlings without making allowance for oil that belonged to the solids?

A. It is counted as new oil when you include with the initial feed your circulating feed.

R-Q. 414. How are the figures obtained in the column under "pounds new oil added" and the sub-head "per ton total feed"?

A. The total weight of oil per day is divided by the tonnage of circulating feed plus the tonnage of initial feed or new feed.

R-Q. 415. "Circulating oil" subhead "total pounds," how is that obtained, the first number being 953?

A. Our analysis showed that we circulated 23 tons of feed that day, and that is multiplied by the analysis which gives the amount of oil per ton in the circulating feed.

R-Q. 416. Was it your intention in performing this experiment #1 to show the effect of 1.6 pounds of oil per ton or the effect of 6.87 pounds per ton?

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A. I was trying to get down to as small a quantity as I probably could and I did not know how much it would be.

R-Q. 417. What does it show in fact, the effect of how much oil per ton?

A. Well, it shows that we couldn't get good metallurgical results.

R-Q. 418. I know, but the result you got is the effect of how much?

A. Oil per ton of solids, 6.87.

R-Q. 419. Is there anything upon this tabulation to indicate that it is intended to show the effect of 1.6 pounds of oil per ton of ore?

A. No, sir.

R-Q. 420. As I understand your explanation these middlings are constantly coursing through the apparatus?

A. Yes, sir.

R-Q. 421. And the tonnage that you get, for instance, that 23 tons, in connection with your experiment No. 1, exhibit 31, indicates that during that period of time, whatever it was, eight hours, 23 tons of these middlings circulated through the apparatus?

A. Yes, sir.

R-Q. 422. And that each ton of the middlings so circulating carried the amount of ore stated in the table?

A. Yes, sir.

R-Q. 423. Or, isn't that stated?

A. It isn't stated in the table.

THE COURT: How much is it?

A. I don't know.

THE COURT: You said you had 23 tons of middlings, and 1,195 pounds of old—1,195 pounds ore or oil, is that right or did I misunderstand you?

A. That is the total, not the circulation, 1,195; there is 953.

THE COURT: You are right.

THE WITNESS: Did I answer your question?

THE COURT: Yes, I made a mistake in the heading there.

R-Q. 424. MR. SCOTT: You gave the figures for the amount of oil on concentrates and tailings, I think, and what it was in your answer to a question?

A. I did.

R-Q. 425. Was that upon the treatment of slimes by flotation or the low grade concentrate?

A. That was the low grade concentrate.

R-Q. 426. Have you corresponding figures for the slime treatments?

A. I don't think that I have them here.

R-Q. 427. You did not make these oil assays yourself, did you?

A. No, I did not.

R-Q. 428. You are not a chemist by profession, are you?

A. No, sir.

R-Q. 429. In connection with the experiments recorded in exhibit 32, serially, the result obtained from commercial experiments in slime feed you were asked

Thomas A. Janney.

as to the effectiveness of the part of the mixture containing paraffin base distilled and gilsonite, and you answered that you had never tried that in a mill but that you had tried it in a laboratory?

A. Yes, sir.

R-Q. 430. With what results?

A. With a recovery of about 54 per cent when I used 20 pounds per ton.

R-Q. 431. 54 per cent recovery?

A. Yes. It was approximately 54 per cent, if I remember correctly.

RE-CROSS EXAMINATION.

BY MR. GARRISON:

RX-Q. 432. Now, Mr. Janney, do I understand you from this table and the first experiment that 23 tons of circulating feed carried 953 pounds of oil?

A. Yes, sir.

RX-Q. 433. A half ton of oil to 23 tons of metal; is that correct; pretty nearly half a ton?

A. That is what the figures indicate.

RX-Q. 434. Well, do these figures correctly indicate the fact?

A. Yes, sir.

RX-Q. 435. Now, your experiment of the second was on the 29th of March, was it not; was it a twenty-four hour run?

A. Second experiment was on the 29th of March.

RX-Q. 436. And it was a 24-hour run?

Thomas A. Janney.

A. Yes, sir.

RX-Q. 437. And the third experiment was the 28th of March?

A. Yes, sir.

RX-Q. 438. And it was a 24-hour run?

A. Yes, sir.

RX-Q. 439. And the fourth experiment was the 27th of March with a 24-hour run?

A. Yes, sir.

RX-Q. 440. And the fifth was the 26th of March, with a 24-hour run?

A. Yes, sir.

RX-Q. 441. And the 6th was the 25th of March with a 24-hour run. Is that right?

A. Yes, sir.

RX-Q. 442. Now, I understood you that with respect to each of these consecutive dates that I have given you, when you ran for twenty-four hours, the amount of material that was in your

P. 2628, After L. 22, insert "Re-x-Q. 443. The Dorr thickener was not known to you when you began the next twenty-four run?"

RX-Q. 444. I am not talking about oil at all. I am talking about the pulp?

A. Yes.

RX-Q. 445. You did not know how much pulp it contained nor how much oil it contained? You do not know how much pulp was there?

A. No, sir.

RX-Q. 446. And of course you did not know how much oil that pulp contained if you did not know how much pulp there was?

A. No, sir.

WITNESS EXCUSED.

RALPH AUGUSTUS CONRADS, called as a witness in behalf of the defendant, being first duly sworn, testified as follows:

DIRECT EXAMINATION.

BY MR. SCOTT:

Q. 1. Please state your full name?

A. Ralph Augustus Conrads.

Q. 2. And where are you at present employed? In what capacity?

A. I am employed as metallurgist, metallurgical engineer at the Magna plant of the Utah Copper Company, Garfield.

Q. 3. What experience have you had in the line of your present employment?

A. Do you wish my general experience? Is that what you refer to?

Q. 4. And education?

A. Throughout the general industry?

Q. 5. Yes.

A. I graduated from the Missouri School of Mines in mining engineering in 1904 and from the fall of

1904, to the fall of 1905, I was employed in the concentrator at Coppertown, Utah, of the Utah Copper Company. From the fall of 1905 until the fall of 1906, about one year, I was with the Balaklala Consolidated Copper Company on general engineering work and mine work in Shasta County, California. Following that I was for about six months with the Annie Laurie Mining Company in mine work and cyaniding. In 1907, from May until October, I was in coal mining work, in the engineering department in Mexico. From there I went to the Esperanza Mining Company in El Oro, Mexico, as mining engineer. About June, 1908, I was made assistant manager of the company, and remained in that position until February, 1911. After that I was in the same capacity—that is, assistant manager of the Dos Estrellas Mining Company at El Oro, Mexico. Following that I was director, or manager of a property in the state of Mexico, the Santa Ana Esperanza. I returned to this country in 1914, and in May, 1915, I went to work for the Utah Copper Company and have been in their employ ever since that time to the present date.

Q. 6. Is the flotation section in the Magna mill under your direction and charge?

A. It is, yes, sir.

Q. 7. What kind of material is treated by flotation there?

A. We are treating a part of the low grade concentrates.

Q. 8. Anything else?

A. No.

Ralph Augustus Conrads.

Q. 9. Just the low grade concentrates?

A. Yes.

Q. 10. Is this sample similar to that at the Arthur by screen analysis?

A. It is a similar product, quite similar. The screen analysis of our flotation heading—I have here the screen analysis of February, 1917, which shows—do you want the complete screen?

Q. 11. Just approximately; I don't care about all the intermediate grades; how much goes through 150 screen, for instance?

A. There is 61.04% that will pass a 200 mesh screen. The corresponding sample for the month of January showed 62.13% passing a 200 mesh. That would be about representative, I think.

Q. 12. Have you made any investigation of flotation in the laboratory as distinguished from the actual work in the mill?

A. Well, yes, but the laboratory work at the Magna plant—we are not equipped there for extensive laboratory work, and our experiments really, while we have tried out certain things in the laboratory on a small scale—our experiments have generally been made on a large scale. When we are satisfied that a thing is worth trying out, we have tried it out on a large scale ordinarily.

Q. 13. Which is the most reliable test, or which test is the most favorable, the laboratory test or the mill test?

A. Why, the mill test, naturally; it gives you operating conditions and tonnage, etc., which are more indicative.

Q. 14. If a thing will not work in the laboratory does it necessarily follow that it will not work in the mill?

A. Not necessarily, it has been my experience; that is, not entirely so.

Q. 15. You have a record, I believe, of the flotation operations at the Magna plant, covering the periods from September 1st, 1914, to December 24th, 1916?

A. Yes.

Q. 16. Was this record prepared either by you or under your direction?

A. It was prepared under my direction.

Q. 17. And were the operations that are recorded there, carried out under your direction?

A. I was not at the plant during the entire time covered by this report.

Q. 18. Will you please state just the time when your connection with the plant began?

A. My connection with the Magna plant began in August, 1915.

Q. 19. And who had charge of them before that, if you know?

A. I should say—I think Mr. Tom Janney—at least I know that he had charge part of the time.

Q. 20. Mr. Janney who just testified before you?

A. Yes, sir. And I believe that probably Mr. Riser—I am not sure that he had charge of the flotation department, but he was at the plant. Mr. Tom Janney had it part of the time.

Ralph Augustus Conrads.

Q. 21. Now, referring to the part of this report subsequent to August, 1915, you may state whether it is an accurate record of what took place?

A. It is an accurate record, accurately kept, and to the best of my knowledge and belief, it is accurate in every detail.

Q. 22. Now, have you a similar record of the operations subsequent to December 24th, 1916, kept by the months?

A. I have a summary similar to that which has been kept, beginning December 25th, 1916, up to and including April 7th, 1917.

Q. 23. And were the operations for this period under your direction?

A. They were, yes.

Q. 24. During the entire period?

A. Of course I have been absent from the plant for very short periods, but they were under my direction completely.

Q. 25. Does this document headed, "Composite Flotation Retreatment Plant Results from December 25th, 1916, to April 7th, 1917, Inclusive," correctly represent the operations of the plant during that period?

A. Yes, sir.

Q. 26. Now, why were the operations up to December 24th calculated in one statement, and the latter operations in another statement?

A. Because prior to December 24th, 1916, we operated with the use of less than one per cent. of oil, and on that date or from that time forward we have operated with the use of a greater amount of oil.

Q. 27. How did the results compare during the two periods?

MR. GARRISON: Now, if your honor please, I want to make the same objection that I made to the testimony of the other witnesses, that there is no connection between this and the prior art, and they have no right to introduce it at this stage of the proceedings.

MR. WILLIAMS: I suppose it is only necessary to suggest that we would like to have these tables to refer to while counsel is examining about them.

MR. SCOTT: Well, I did not think I would get into the middle of them, it is so near adjournment time.

THE COURT: Were you just trying to use up the time?

MR. SCOTT: No, sir, I was going on asking the questions, but I did not want to hunt up the duplicates now.

THE COURT: The objection will be overruled. If it appears later that it has not been connected up with the condition of the prior art, the objection may be renewed, but otherwise it will be in the record if some other court has to pass upon it.

MR. GARRISON: What about this objection based upon the fact that the tables have not been submitted to us?

THE COURT: Well, Mr. Scott will submit them. He says that he was—I think you call it stalling, don't you? (Laughter.)

Whereupon further hearing was adjourned until Friday, April 20th, at 10 a. m.

Ralph Augustus Conrads.

Friday, April 20th, 1917, 10:00 a. m.

Trial resumed pursuant to adjournment, all parties present; whereupon the following proceedings were had:

MR. SCOTT: I now offer in evidence the two tabulations which Mr. Conrads identified and verified yesterday, but before doing so I will ask a question.

Q. 28. I would like to ask how far back in point of time you are able to testify as to the accuracy of this tabulation, covering the period from September 1st, 1914, to December 24th, 1916. You testified to the date yesterday, but I don't remember whether I asked you if your knowledge covered the whole period?

A. From August, 1915, to the last date.

Q. 29. December 24th, 1916, is the last date?

A. To the end of it.

Q. 30. Have you any knowledge as to who was in charge in the period prior to August, 1915, extending back to the beginning of the report?

A. As I said yesterday, Mr. Tom Janney had charge during a part of the time prior to that, though just exactly how much of the time I could not say.

MR. SCOTT: Subject to the introduction of further proof prior to August, 1915, I offer in evidence the report entitled "Utah Copper Company, Magna plant, flotation retreatment plant results treating mineral classifier overflow and fourth and fifth spigots, September 1st, 1914, to December 24th, 1916, inclusive." I will supply the court a copy immediately.

Q. 31. As to this other report which we discussed

yesterday, I believe you stated that you were in charge during that entire period?

A. That is the one subsequent to the first?

Q. 32. Subsequent to December 24th, 1916?

A. Yes, sir.

MR. SCOTT: I offer in evidence the report entitled "Utah Copper Company, Magna plant, metallurgical department, composite flotation retreatment plant results for period December 25th, 1916, to April 7th, 1917, inclusive."

Papers admitted in evidence and marked Defendant's Exhibits 35 and 36.

MR. GARRISON: I desire to cross-examine before this paper is admitted.

BY MR. GARRISON:

Q. 33. Mr. Conrads, I hand you the paper marked Defendant's Exhibit 35 and ask you what your relation was to the work that is represented on that sheet?

A. I was in charge.

Q. 34. Oh, yes, I know as to the date.

A. My relation?

Q. 35. Yes.

A. I was in charge of the entire direction of the work, the results of which are represented on this sheet.

Q. 36. You were the man who had practical charge of the work?

A. I had charge of the entire department.

Q. 37. You were the man who had practical charge of the work, by somebody else bringing you reports—not theoretical charge, but actual charge of what was done, and what was done was done by your orders?

Ralph Augustus Conrads.

A. With this exception. I have the direction of the plant, but the operators naturally are under the mill foreman, but I direct the work. I would order any changes that were made and I watched the result.

Q. 38. You were the metallurgical engineer?

A. Yes, sir.

Q. 39. You are not the man who has charge of the plant practically, practical charge of the work?

A. I am in charge of the plant. The men, the operators themselves, are under the immediate direction and responsible to the mill foreman, but so far as the dictation of what they shall do in the plant and the operation of the plant, I dictate that.

Q. 40. In other words you lay down a policy and they carry it out?

A. The general mill foreman is directly over them, but the plant is run at my direction.

Q. 41. In other words you lay down a policy and they carry it out?

A. Yes.

Q. 42. What you know with respect to what they do is contained in reports that are furnished to you by or through the mill foreman, is not that correct?

A. I have a personal knowledge, because I spend a great deal of time right in the plant.

Q. 43. Do you go from point to point every day and put down notations yourself about what is being done?

A. I make the rounds regularly, or at various times, noting the conditions and everything pertaining to the plant in its operation.

Q. 44. Is this sheet made up from your own original notations?

A. That sheet is made up from results which we systematically get.

Q. 45. (Question read: Is this sheet made up from your own original notations?) Answer yes or no?

A. It is not.

Q. 46. Then this sheet is made up of something written down on paper by somebody else and furnished to you? Isn't that correct?

A. This sheet is made up of tonnage measurements which are regularly and systematically taken, of the percentage of solids in the feed and the various items contained in that report are done in a regular and systematic way and under my direction.

MR. GARRISON: Read the witness the question. He has not answered it.

(Question read as follows: "Q. 47. Then this sheet is made up of something written down on paper by somebody else and furnished to you? Isn't that correct?)

MR. GARRISON: Yes, or no?

A. It is compiled from regular and systematic reports which I received.

MR. GARRISON: Read the witness the question; he has not answered it.

(Question read as follows: "Q. 48. Then this sheet is made up of something written down on paper by somebody else and furnished to you? Isn't that correct?")

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MR. GARRISON: Yes, or no?

A. I think I answered that question.

THE COURT: He has asked you if you received written statements and reports from others and you say you received reports, but you do not say whether they were written or not. You may answer it yes or no, and then qualify it.

A. Yes, I received written or typewritten statements of regular operations.

MR. GARRISON: Q. 49. And this is what this sheet is made up from?

MR. KREMER: You have a perfect right to explain it as the court told you.

THE COURT: Read the witness the answer.

(Answer read as follows: "Yes, I received written or typewritten statements of regular operations.")

MR. GARRISON: Do you want to add anything to that?

THE WITNESS: (Continuing)—which cover the operations of the department in detail as represented on this sheet and which are regularly and systematically taken and reported to me.

Q. 50. Then this sheet is compiled from reports of this character that are furnished to you; isn't that correct?

A. Yes, sir.

Q. 51. Do you yourself make any of the calculations which appear upon this exhibit, for instance "percentage of solids," do you make up the calculations which result in the figures which appear in the column headed "Percentage of Solids"?

A. I personally do not make up the figures. I do, however, endeavor to check them sufficiently to satisfy myself as to their accuracy.

Q. 52. Is that true with respect to all of the other headings and the figures underneath?

A. Yes, sir.

Q. 53. They are furnished originally by someone else, but you endeavor to check them sufficiently to be assured of their accuracy? Is that correct?

A. Yes, sir; to the extent that I reasonably can, considering the amount of work embraced in the department.

MR. GARRISON: I have no objection to the competency of this, subject to our usual objection as to its relevancy.

Q. 54. Now, with respect to the paper marked defendant's exhibit 36, what you have said with respect to the source of information, and the compilation under your own personal supervision as to exhibit 35 is also true with respect to 36?

A. With this exception: that on the former exhibit referred to I can only personally testify as to results of a part of that.

Q. 55. You mean as to the date?

A. As to the date. But in other respects this is exactly similar. I can testify in the same way to that.

Q. 56. And it was made up in the same way?

A. Yes, sir.

Q. 57. From the same sources, and your personal perception is the same?

A. Yes, sir.

MR. GARRISON: I have no objection to the competency of this. I object to its relevancy. I think it is plainly irrelevant.

THE COURT: You have the general objection, I suppose.

MR. GARRISON: Yes, sir.

THE COURT: Estoppel, and all?

MR. GARRISON: Yes, sir. What I would say, I think this paper is competent if the evidence is relevant. He has competently proven the paper but I do not think it is relevant.

THE COURT: The objection as to estoppel, you must remember you have claims 9, 10 and 11 which certainly there would be no estoppel on by virtue of the judgment in the other suit at least, but the same ruling will be made, and of course will be all finally determined at the end of the suit, and an exception allowed.

MR. GARRISON: Yes, sir.

Whereupon the sheets were admitted in evidence and marked defendant's exhibits 35 and 36.

DIRECT EXAMINATION (Continued).

BY MR. SCOTT:

Q. 58. Mr. Conrads, this first report from September 1, 1914, to December, 1916, has been designated exhibit 35, and I will use that for brevity, and the next one has been received in evidence as exhibit 36.

Ralph Augustus Conrads.

A. Exhibit 35 covers the period from September 1st, 1914?

Q. 59. That is it; that is 35. The other one is exhibit 36.

MR. GARRISON: Have you any copies of that?

MR. SCOTT: No, I have not. This is the only copy.

MR. WILLIAMS: I give you notice that for the purpose of cross-examination I must have an extra copy of these exhibits to hand to my experts.

MR. SCOTT: The court has an extra copy and you can use the original.

THE COURT: Be careful that no other markings are made.

MR. SCOTT: Mr. Conrads, will you just tell us briefly how these figures are ascertained in the first column, in exhibit 35, "Tonnage". I mean the physical method of finding out what that tonnage is.

A. At the head of the flotation plant or flotation machines, there is a sludge tank into which the feed which is prepared for treatment is laundered, and that figure of tonnage is arrived at by weighing the entire flow for a brief space of time, getting its weight, for instance, for a period of 15 or 20 seconds, and at the same time taking a sample to determine the percentage of solids contained in the flow. By that means we are able to determine the percentage of solid material entering the machine for a definite space of time; and as that is repeated during the day at regular intervals, the tonnage for the day is compiled from that.

Ralph Augustus Conrads.

Q. 60. On this table, exhibit 35, that part of it to which your knowledge extends, is any account taken of the circulating oil?

A. No.

Q. 61. Before we proceed any further, Mr. Conrads, will you make just an outline sketch that you can draw in three or four minutes, probably, of the position of these different flotation cells, with arrows, and so forth, to designate the course of the pulp and the return of the middlings, if there are any, and the position of the cleaner, if there is one, so that your testimony will be clear—nothing elaborate, but just a rough outline.

A. Just a rough sketch of the original flow, the disposition of products and the circulating feed?

Q. 62. And the cleaner, if any.

A. (Witness drawing.) I think that about represents it. The original feed which is prepared for flotation, flows into the sludge tank, which is marked here "sludge tank." The sludge tank receives in addition to this original or new feed the circulating load from the lower end of the machine; that is, the cells which are not making a finished high grade concentrate. Those overflow directly—that overflowing froth is run into the launder which I have marked circulating feed launder—

Q. 63. Tell the court what each of these circles and things represent; I don't know that he understands.

A. Oh, yes. I was getting a little ahead of my story. What I have endeavored to represent here is the gen-

eral plan of one full section of the flotation department, which consists of a sludge tank, a mixing box, where the oils and reagents are introduced—

Q. 64. The oil is added in the mixing box and whatever reagents you use—they are added as it comes from the sludge tank?

A. The feed from the sludge tank is drawn through a molasses gate or plug into the mixing box, where it is mixed with the new oil and in our case an alkaline reagent. From there it flows to the first emulsifying cell.

Q. 65. What is that emulsifying cell?

A. It has been described before in connection with the Janney machine. It is simply a cell which is equipped with a vertical motor, driving impellers, which run at the rate of 570 revolutions a minute under full load.

Q. 66. What effect does that have upon the pulp?

A. That is the agitating or emulsifying operation, the preparation of the feed.

Q. 67. Does it mix the oils and the reagent up with the pulp?

A. Yes. Now I have indicated here the three emulsifiers, which are in series. The feed goes into the first, and leaving that it goes into the second and the third. From the third it goes into the first treatment cell, of which there are 16 in the section. I don't know just how many I have represented, but that is immaterial I guess.

Q. 68. You have represented about 12?

Ralph Augustus Conrads.

A. Well, I have marked "and so forth."

Q. 69. Well, I see you have eleven, so the and so forth means five?

A. All right. Well, to go ahead with the flow, after passing the emulsifiers the feed flows into the first cell from which it overflows into spitzkastens on the side, these being double spitzkasten there is a spitzkasten on either side.

Q. 70. What is a spitzkasten? And what is its purpose?

A. The spitzkasten is a pointed box.

Q. 71. Pointed at the bottom?

A. A "V" shaped box into which the pulp from the cell proper, where it is agitated, overflows. There the froth flows off of the top and falls into a launder.

Q. 72. What is the purpose of flowing the pulp into the spitzkasten, to gather the froth?

A. It is a quiescent state.

Q. 73. The pulp is quiet here and that permits the froth to rise?

A. Yes. Here it is subjected to a very violént agitation, and overflowing from that cell it goes out into the spitzkasten, where it is relatively quiet.

Q. 74. Under flowing from one to the other?

A. Well, it overflows in this case. The pulp from the cell into the spitzkasten is introduced under a baffle, which submerges it about two and a half inches under the level of the pulp, and the spitzkasten—now, I have indicated here three cells as going to high grade, which is a variable quantity. In the case of extreme

heavy mineral load it is more, and in the case of a lighter load it is less. In other words, we simply cut in more cells to high grade and less to low grade as the conditions warrant.

Q. 75. You mean that the product from these three or four cells is taken off separately from that of the latter cells?

A. Yes; these first cells make a finished concentrate which is high grade and ready for shipment when settled, without any further concentration.

Q. 76. How about the lower cells?

A. The lower cells are not; they are lower grade; containing more silica and having a lower grade concentrate which is not sufficiently concentrated or clean enough to be considered finished or ready for shipment.

Q. 77. What is done with the concentrate from these lower cells?

A. From these lower cells that concentrate is returned to the sludge tank and reintroduced, along with a regular feed.

Q. 78. That is your circulating load?

A. That is our circulating load? I have indicated on this sketch only three cells going to high grade, and the balance being returned to circulating load; however, that is a variable condition; we can cut in four or five or six or all, if necessary.

Q. 79. Just make a note there that there are 16 cells there; three emulsifiers and sixteen cells?

A. Yes, I will make that.

Q. 80. Is there any thickening in this sludge tank, or is it simply a receiving tank?

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A. That is a receiving tank.

Q. 81. No Dorr thickener makes a part of this plan?

A. No. We have a Dorr thickener, but it is ahead of this. The sludge tank receives the thickened pulp. I have only represented this from the point after the thickened feed goes into the plant.

Q. 82. After the thickened material goes into the sludge tank it never goes to the Dorr thickener again?

A. No, sir, not after it comes in here.

Q. 83. This is the final tailings, which comes out at the end of those 16 cells?

A. The final tailing from here is the final tailing of the mill.

Q. 84. These cells are in series; what leaves one goes into the next and so on.

A. A straight series from start to finish. Every bit of feed that enters this first emulsifier, or every bit of feed into the section enters the first emulsifier and flows in series to the second emulsifier and to the third emulsifier, and in series right through the machines.

Q. 85. Part of the froth being taken off as it goes on through?

A. Yes, exactly, either to high grade or to circulating load.

MR. SCOTT: I offer the illustrated sketch made by the witness in evidence.

Sketch admitted in evidence without objection and marked Defendant's Exhibit No. 37.

THE WITNESS: I did not indicate on there anything about the tailing or the waste product, I have only indicated the concentrates.

Q. 86. Well, you can put an arrow showing where the tailing goes; that will be sufficient, I guess.

A. All right, I will do that. (Witness drawing).

Q. 87. In this table, exhibit 35, in evidence, is any record made or account taken of the circulating load or the oil in the circulating load?

A. In exhibit 35?

Q. 88. In exhibit 35.

A. There is not.

Q. 89. Does this sketch, which you have just made, exhibit 37, represent one of the several sets of apparatus?

A. One of two at the Magna plant.

Q. 90. And that comprises the Magna plant, those two sets of apparatus similar to what is shown on exhibit 37?

A. Yes, sir.

Q. 91. Just state the extreme limits, the range of the amount of oil shown on exhibit 35.

A. The extreme range as indicated there—

Q. 92. (Interrupting) Per ton, I mean.

A. Yes. The lowest amount of oil used in that period was an average for the month of March, 1915, which was 1.23 pounds of oil per ton.

Q. 93. And the highest was?

A. The highest was 5.37, which was the month of April, 1916.

Q. 94. Does the record in evidence as exhibit 36, take into account the circulating load, both of solids and oil?

Ralph Augustus Conrads.

A. Yes.

Q. 95. About the center of the sheet there is a column entitled "Pounds, New Oil Added." Now just tell us what the figures in that column represent.

A. The figures in that column headed, "Pounds of New Oil Added" is the actual weight in pounds of new oil, that is not considering oil from circulation.

Q. 96. That is the oil consumption rather?

A. Yes, that indicates or represents the new oil consumed.

Q. 97. Now, referring to the column entitled "Pounds of Oil in Circulation," please state what the figures in that column represent and how they are determined.

A. Pounds of Oil in Circulation?

Q. 98. Yes.

A. That represents the total amount of oil in that circulating load.

Q. 99. The figures being for the month—this being monthly statement?

A. Yes, that is for the month.

Q. 100. Now, will you tell me how these figures are determined? I don't want the assay method, but I want the way of getting the samples, etc.

A. The return feed or circulating load is regularly sampled as it enters the sludge tank and the amount of oil is determined in that feed, from samples, in pounds per ton of wet feed is the way that we originally determined it.

Q. 101. Pounds per ton of wet feed?

A. Of wet circulating load. At the same time we get another sample which is dried in order to determine the per cent of solids in the feed or in that circulating load. From these we can calculate the various things that we want for this sheet.

Q. 102. The next column is entitled, "Excess pounds of Circulating Oil." Now I wish you would explain the meaning of that heading and what the figures represent.

A. The excess pounds of circulating oil is the amount of oil left after satisfying the dry tonnage in the circulating load with 20 pounds of oil per ton.

Q. 103. You name 20 pounds because you were aiming to supply—

A. (Interrupting.) We were aiming at 20. I was going to modify that in this way: There have been times that I ran some tests which will probably be referred to, in which we used varying amounts, and at that time, that dry tonnage in the circualting load was satisfied with its amount, that is, the amount that we were aiming at during that test.

Q. 104. So the word "excess" mean excess over and above the amount of oil per ton of solids you are attempting to supply to the machine?

A. Exactly.

Q. 105. And if that amount you are trying to get is 20 pounds, why, the excess is the excess over and above 20 pounds?

A. Yes. We calculate the total amount of oil in that circulating load. We calculate the total dry ton-

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nage in the circulating load. Then we deduct from that total amount of oil sufficient oil to satisfy that dry tonnage which is entering the head of the machine in the circulating load and credit the excess oil as a balance.

Q. 106. What is the object of determining that oil in the circulating load, in determining its excess over the predetermined amount you are attempting to supply.

A. In order to ascertain the total amount of oil entering the machine.

Q. 107. And what relation does it have to the amount of new oil you have?

A. Well it simply augments.

Q. 108. Simply what?

A. It just augments the amount. If we have, for instance, 15 pounds of new oil per ton going into the machine, and we have 10 pounds, for example, of excess oil from circulation, it shows a rate of 25 pounds of oil entering the head of the machine per ton of dry feed entering it. Does that answer the question?

Q. 109. I think so. The column entitled "Pounds of Oil in Circulation" contains figures which are obtained how?

A. "Pounds of Oil in Circulation"?

Q. 110. Yes. That is the one we just had.

A. That is the one we explained.

Q. 111. Yes, I made a mistake. The column I meant was, "Total Pounds of Oil, New, Plus Excess."

A. "Total Pounds of Oil, New, Plus Excess" is the

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figure I referred to just a minute ago. That is, the pounds of new oil per ton of original feed plus the pounds of circulating—excess circulating oil per ton of original feed.

Q. 112. Take the second entry there for the month of January, that is obtained simply by adding 528,760 in the "Pounds of New Oil" column and the 103,358 in the "Excess Pounds" column, gives us 632,118 pounds?

A. Correct.

Q. 113. Now the pounds of new oil per ton is simply a matter of calcualtion from the preceding column?

A. The pounds of new oil per ton?

Q. 114. Yes, that column is simply—

A. (Interrupting.) That is simply the total amount of oil divided by the total tonnage of new feed.

Q. 115. The column "Pounds of Circulating Oil Per Ton" of new feed is figured on the entire tonnage, including new feed and the circulating load?

A. The pounds of circulating oil per ton—yes, that is the total circulating oil divided by the tonnage.

Q. 116. Now, taking this column "Total Pounds of Oil Per Ton, New, Plus Excess," the figures in which two columns are added to obtain the figures in that column?

A. The figures in the column "Total Pounds Oil Per Ton, New, Plus Excess"?

Q. 117. Yes.

A. That is the sum of the "Pounds of New Oil Per Ton" and the "Pounds of Excess Circulating Oil Per Ton".

Ralph Augustus Conrads.

Q. 118. In the case of the month of January the sum of 18.41 and 3.60?

A. Right.

Q. 119. Now, I notice that in the month of January, which is the second entry, you take credit for 3.6 pounds per ton of excess circulating oil?

A. Yes, sir.

Q. 120. Have you any explanation as to how that amount of circulating oil builds up in the apparatus?

A. How the circulating load or the amount of oil in circulation builds up?

Q. 121. Yes, how it builds up to that extent.

A. Well, that is a condition which arises in various places, in metallurgical plants. Now, for instance, we introduce a certain amount of oil, of new oil, into the head of the machine. There is a part of that oil which is discharged with the concentrate and is lost to circu-

P. 2653, L. 20, insert "from these return cells which to make up the circulating load contains a certain amount of oil, the froth" after "froth"

into the head of the machine, it meets the new oil, and that process is repeated, some of the oil being lost in the concentrate. That is lost from the machine, and as you go down, the macihne, the return cells continually throw over oil which is returned into circulation.

Q. 122. Referring to these lower cells of the series from which the froth is returned as a middling to the sludge tank, does that froth carry with it more or less water when it goes back?

Ralph Augustus Conrads.

A. Yes, sir.

Q. 123. And what is its condition as to its capability of flowing in a launder?

A. Well, it is sufficiently thin to flow.

Q. 124. Thin enough to flow?

A. Thin enough to flow, yes.

Q. 125. And the oil that is carried back with these middlings, where is it; in the water or in the concentrate or both or what?

A. Well, that—to say exactly where that is, I can not tell you just in what proportions that would be represented in the water or in the mineral, or exactly what the various proportions of that oil is, but it is certainly safe to say that a great deal of it is carried right in the water, in the general water.

Q. 126. Your determination simply is a determination of the total amount of oil regardless of whether it is sticking to the solids that are in the water, or whether it is emulsified in the water; is that the idea?

A. Our determination is simply the amount of oil in that feed, regardless of what it is or what condition it is in.

Q. 127. Now, during these months from December to April, recorded on exhibit 36, I note you have used quantities of oil for January, February and March in excess of 20 pounds; I would like you to compare the metallurgical results obtained during these months with the metallurgical results shown on exhibit 35 covering the period when smaller amounts of oil were used.

A. Well, one of the most noticeable things, or first

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to be noted is the comparison in the per cent of copper in the tailing. Now, in exhibit 35 we have an average of .290 as a per cent of copper in the tailing. That is, that represents a loss. Now, on exhibit No. 36 we have in the corresponding figure, .157.

Q. 128. Well, I am talking now, the average for the five months.

A. Yes.

Q. 129. Now, will you make the same comparison individually with January, February and March, during which months the amount of oil was above twenty pounds?

A. Well, we have in January—we used an average of 22.01 pounds of oil per ton, and our average tailing for the month was .106 per cent copper. For February we used an average of 23.21 pounds of oil per ton and made a tailing containing .121 per cent of copper. For March we used 20.62 pounds of oil per ton and made a tailing of—that figure is blurred a little bit; it looks like .161.

Q. 130. It is .181 here?

A. .181 that figure is. It is a little blurred on this copy. Now for the month of April, which will naturally attract anyone's attention, the tailing there is .402.

Q. 131. Isn't it .401?

A. .401, yes. But that is due to another cause.

Q. 132. What was the cause?

A. Well, during that time I made some tests or rather, complete day runs in a reduced amount of oil. You will see that the average for those first seven days was 16.08.

Q. 133. This table does not show anything about the seven days. You know that cannot cover the whole month?

A. No.

Q. 134. How many days does it cover in April?

A. The days on which we used the low amounts?

Q. 135. Yes.

A. The first and second.

Q. 136. Well, this average result for April, which part of April do they cover?

A. From the first to the seventh inclusive.

Q. 137. Now, will you make the same comparison as to the indicated extraction under the conditions represented upon exhibits 35 and 36?

A. Referring to exhibit 35 the percentages of indicated extraction—the average for the entire period waws 97.461 per cent, and for the subsequent period covered by exhibit No. 36 the indicated extraction for the entire period was 98.161.

Q. 138. How about the individual months during that period represented by exhibit 36?

A. Well, the individual months, with the exception of the seven days in April and for which I suggested an explanation as to the cause of that low extraction —with that exception the indicated extraction is above 98 per cent, in fact very close to 99 per cent in two cases.

Q. 139. How about the month of March?

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A. That is, above 98 in three cases, and in the month of March 97.887, which is practically 98 per cent.

Q. 140. How does the grade of the concentrate compare in value during the periods represented by exhibits 35 and 36?

A. Well, for exhibit 35 the average of the concentrate produced was 30.294 per cent copper, and for the subsequent period covered by exhibit 36, the average is 28.458.

Q. 141. That is, taking into the average the April results?

A. Taking into the average the April result, yes, 24.731.

Q. 142. And while you are stating that, just state the copper contents for December, January, February and March of the concentrate?

A. The copper content of the concentrate for December was 33.218; for January 29.414; for February 29.337; for March 27.369.

Q. 143. Does any factor enter into the value of these copper concentrates other than the amount of copper, the proportion of copper?

A. Yes, the percentage of silica or insoluble is one factor.

Q. 144. State what that has to do with it, the percentage of silica.

A. The percentage of silica is a disadvantage, in that it represents so much material which carries no

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value—that is, metallic or mineral value. The freight transportation has to be paid on that.

Q. 145. Does it have anything to do with the smelting?

A. And also in smelting if there is an excess of silica over iron the smelting of that has to be paid for specially.

Q. 146. If the silica and iron balance each other, it leads to no additional smelting charge?

A. It leads to no additional smelting charge. There is an additional charge when the silica exceeds the iron content.

Q. 147. How do these concentrates, during the period represented by exhibit 35, compare with those for the period represented by exhibit 36 in the matter of the relation of the amount of silica and iron?

A. For the period covered by exhibit 35 we have an average percentage of 21.013 per cent iron and 16.116 per cent insoluble. For the period represented by exhibit 36 we have 21.196 per cent iron and 17.359 per cent insoluble.

Q. 148. Do you regard the difference between these figures as substantial or not?

A. In the view of other results it is not. Now there is an excess—I haven't figured it exactly, but there is about five per cent excess of iron on exhibit 35 and in round numbers four per cent on exhibit 36; in both cases the iron exceeds the silica.

Q. 149. That is the principal thing, is it?

Ralph Augustus Conrads.

A. That is the principle thing—that is, not the principle thing, no; in that connection it is the principle thing, but the principle thing really is the difference in the extraction, as represented by the very much lower tailing during the last four months, or since December 25th.

Q. 150. In our operations do you encounter any other instance of a circulating load, other than the circulating load we have discussed in connection with this flotation operation?

A. In general you mean?

Q. 151. Yes, in general metallurgical operations?

A. Why, yes; that matter of circulating load, we find that frequently in one connection or another. There is a very simple one, for instance, in a crushing plant. Take, for example, a plant which is, we will say, crushing a hundred tons a day, now that feed, we will say is crushed in rolls for example. After passing the rolls it is screened. The under size is passed on for further treatment, while the over size or the part that is not reduced fine enough to pass the screen, is returned to the rolls for regrinding. Now, we have that steady constant rate of 100 tons per day of new material. That circulating load, due to this returned over size, may build that load up so that you are crushing—the work that the rolls are actually doing will be four or five hundred tons, or perhaps more than that, per day. Now, I think that is comparable, in that we will say you have a hundred pounds of new

oil going into your flotation machine; you have a certain amount that is lost in circulation by going out with the concentrate, we will say; that would compare to the under size from that screen, which is lost to the circulation through the rolls. Then we have the oil which is contained in the middling, or circulating load, which is returned; that would be comparable to the over size which is returned to go through the rolls again. So that at any one minute we would have much more than the indicated rate of new feed as a load for the rolls.

Q. 152. Now, referring again to exhibit 36, we have a column "pounds of new oil per ton." That includes the entire tonnage, the new feed as well as the circulating solids, does it?

A. No.

Q. 153. It does not?

A. No, it does not.

Q. 154. It is pounds of new oil per ton of new feed?

A. Yes. The dry tonnage in the circulation is taken care of by itself in our calculations. We satisfy it with its proper amount of oil before we make any credit for the excess circulation.

Q. 155. What was the material that was being treated during this time recorded in exhibit 35; it is described as being mineral, "classifier overflow, and fourth and fifth spigots" in the title of the record. Can you tell us what that is?

Ralph Augustus Conrads.

A. The material which we treat by flotation is a part of the low grade concentrate made in the mill. Now, in saying a part, I will explain that that part is gotten in this way: the entire product of the low grade concentrate is classified in the hydraulic classifiers of five compartments each. Now the coarsest material which comes down in the first spigot, along with the next coarsest in size in the second, and the succeeding in the third compartment—the products from those three spigots are treated on Wilfley tables. The product from the fourth spigot and the fifth spigot, along with the overflow from that classifier, is pumped to thickeners; we use both the cone tanks and the Dorr thickener for thickening this product. Then the under flow, or the thickened product from both the cone tanks and the Dorr tank is laundered to the flotation plant for treatment.

Q. 156. Have you any figures regarding its fineness?

A. Yes. Well, yesterday I gave the screen analysis of the flotation heading for February as 61.04 per cent passing through a 200 mesh.

Q. 157. Well, never mind; I had forgotten that you gave that.

A. It is quite a fine product.

Q. 158. Was the same material being treated during the period recorded in exhibit 36?

A. Yes.

Q. 159. Generally, was the material of the same character during the periods represented by 35 and 36?

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A. Yes. Now, in going over the old records, I will say that there is just a little difference, which does not amount to anything, and that is, that there was a period of experimentation, when they used some of the third spigot product, but that is only a relative matter; but the product is essentially the same product.

Q. 160. What is the most important element in the operations of your plant, if you can state it in that way, recovery or the grade of the concentrate?

A. Why, recovery is the most important.

Q. 161. Now I believe you have made some tests designed to show comparative results with different amounts of oil, have you not?

A. Yes.

Q. 162. Have you a record of those tests?

A. I have, yes. You refer to the statement marked "statement showing loss in pounds of copper and consequently monetary losses due to abnormal tailing caused by variation in the amount of oil—"

Q. 153. Yes, I believe that is it. The title is "Utah Copper Company, Magna plant, statement showing loss in pounds of copper and consequent monetary loss due to abnormal tailing caused by variation in amounts of oil used per ton of ore treated, December 25th, 1916, to March 24th, 1917, and abnormal test March 25th to April 2nd, 1917." I will ask you if these operations recorded upon this paper were carried out by you?

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A. Yes, sir, under my direction.

Q. 164. And you can state that the results here recorded are correct?

A. To the best of my knowledge and belief I think they are accurate in every detail.

MR. SCOTT: I offer this report in evidence.

Report marked DEFENDANT'S EXHIBIT 38 and admitted in evidence.

MR. GARRISON: I would like to cross examine as to this.

BY MR. GARRISON:

Q. 165. These were experiments were they?

A. Well, if you want to classify them as experiments—we were trying out that condition; if that is what you mean by an experiment—but we did it on full scale operations.

Q. 166. But I mean it was not the ordinary operation in your mill; it was done for the purpose of ascertaining the effect of running your mill under certain conditions?

A. It was a variation in the amount of oil per ton of the ore treated by flotation, but applied to our regular heading and the entire amount of feed under treatment.

Q. 167. (Last question read.) You can answer that yes or no, can't you?

A. I don't believe that that can be answered directly without a certain qualification.

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Q. 168. Why not?

A. Because we are continually varying our conditions; that is, we may be at any time varying our conditions as to the amount and kind of oils, reagents, and such variable things, and we do that in our regular operations.

Q. 169. Those were different conditions, weren't they?

A. We vary our condition from one time to another.

Q. 170. And those variations or different conditions—they were different conditions, weren't they, different one from the other?

A. Yes; we differ one from another in our regular operations—one day from another.

Q. 171. I haven't asked you that. I say when you do make these variations they are with respect to each other different conditions, aren't they?

A. They are different conditions, yes.

Q. 172. Then I will ask you whether or not these things shown on here which are different from the normal and which are designated as abnormal were done for the purpose of ascertaining the nature of the abnormal conditions which are different from the normal conditions; isn't that correct?

A. Yes, sir.

Q. 173. And they were all done by you or under your direction?

A. They were all done under my direction.

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Q. 174. And you are satisfied that you can testify as the verity of the figures?

A. Positively, yes, sir.

Q. 175. And as representing truthfully the conditions that existed in the mill at the time that these figures show the record?

A. Yes, sir.

MR. GARRISON: We have no objection as to the competency.

THE COURT: The result of what we might call the permanent objection is permanently overruled at the present time.

The document admitted in evidence and marked Defendant's exhibit 38.

DIRECT EXAMINATION (Continued),

BY MR. SCOTT:

Q. 176. What was the general purpose of these operations represented by exhibit 38?

A. The general purpose of these operations was to determine and note the effect produced by the reduction in the amount of oil per ton of ore treated without any variation in the oil combination itself, in its proportion; simply in the amount of that combination being used per ton of feed.

Q. 177. In reducing the amount progressively, as I have—as I see you have done, did you adhere rigidly to the conditions prevailing when you used

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the maximum, 22.18 pounds; or did you adapt, as best you could, the conditions to the varying and smaller amounts?

A. Well the conditions—We ran that under two general conditions. We would run, for instance on the 25th and 26th of March, we ran on those two days under the normal conditions of carrying the circulating load and we included, or include the amount of oil in excess of 15 pounds per ton of pulp in the circulating load.

Q. 178. You did that because it was your effort to arrive, as nearly as possible, at 15 pounds per ton?

A. 15 pounds is the amount that we endeavored to maintain, 15 pounds per ton of feed during those two days.

Q. 179. And on March 25th and 26th, the amount, I note, taking into accounts credit for the circulating oil were, 16.17 and 15.84. That is correct is it not?

A. Yes. Now, for March 27th and 28th we eliminated the circulating load.

Q. 180. So that 16.23 for March 27th and 16.41 for March 28th represents the amount of new oil relative to the new feed, the circulating feed being ignored entirely?

A. Yes, the new feed was the total feed on those days because there was no circulating load.

Q. 181. You cut the circulating load out?

A. Entirely, every cell.

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Q. 182. The pulp flowed straight through the machine from end to end without any circulating load at all?

A. Yes. What froth was discharged from each and every cell went directly to the high grade concentrate.

Q. 183. Then, as I understand your last answer, upon these days when you did not take credit for circulating oil, you didn't have any circulation; you eliminated the circulation entirely?

A. Didn't have any; there positively was no circulation at all; no circulating load.

Q. 184. It was not a question of not taking into consideration something that was present, but you simply cut the circulating load out of the system altogether?

A. We absolutely did not have a circulating load.

Q. 185. The first entry is designated "Normal" and the amount of oil is 22.18 pounds. What is the meaning of the word "normal" in that connection?

A. We assume or assumed the average condition as obtained—or average results as obtained from December 25th to March 24th inclusive as the normal condition of operation under the large amount of oil or the increased amount of oil from our prior practice.

Q. 186. Normal, as representing your present mode of operation with over one per cent of oil?

A. Yes. In other words we began the use of the

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large amount of oil on the 25th of December, and at the time that these tests were begun, on the 25th of March, we simply took our average results for the entire period up to that time, and assumed that as the normal figure, as the basis of comparison.

Q. 187. Oh, yes. That entry "normal" you say covers the period from December 25th, as stated, 1916, to March 24, 1917?

A. That is just before these tests were begun.

Q. 188. Now, what was the result of these tests with regard to the efficiency of using less of this mixture than 22.18 pounds which you took as the normal average?

A. Well, we found we got vastly better results with the greater amount than we did with the reduced amount. Now, this statement carries that out for the purpose of comparing the difference in operation, that is, the percentage of copper in the tailings, also the actual loss in operating under the different conditions. And then we go ahead and figure what that loss means in money at the assay of the tailing, that is, the actual amount lost on the actual tonnage of tailing which was discharged from the plant during the test; and that loss is figured at 15 and 20 and 25 and 30 cents per lb. in order to determine the monetary loss.

Q. 189. So that we are sure that we have it right, and instead of having it in this table, suppose you run right down that first column of dates, and the

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amount of oil and just state briefly what the amounts of oil was in each of these runs and how it was computed and whether the machine was circulated—operated with circulation or not.

A. The first figure under the column "Average Pounds Oil Used per Ton of Ore Treated" is 22.18, and that represents the average pounds of oil per ton during the entire period from December 25th 1916, to March 24, 1917, inclusive. Now, on March 25th it was endeavored to maintain an average of 15 pounds of oil per ton including the excess oil from the circulating load. On March 26th the same condition obtained. On March 27th and 28th it was endeavored to use 15 pounds of oil per ton, that being only new oil, though. There was no oil credited from circulation and positively no circulation, as the discharge from every cell was direct into the high grade launder and nothing whatever was returned to circulation. On March 29th there were no tests made. On March 30th it was endeavored to use 10 pounds of oil per ton of feed without circulation, the same condition obtaining as did on March 27th and 28th. All froth was discharged to concentrate launder. On March 31 it was attempted to maintain the oil at 10 pounds per ton including excess oil from circulation, and the excess in this case being after the dry tonnage in circulation was satisfied, with 10 pounds of oil per ton. On April 1st it was attempted to maintain the oil at 5 pounds per ton of feed without circulation.

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And on April 2nd it was attempted to maintain the oil at 5 pounds per ton inclusive of the circulation, inclusive of the excess oil from circulation; and in this case, excess oil is the amount of oil in excess of 5 pounds per ton of dry pulp in circulation.

Q. 190. Now, referring to the column, "Average per cent. Copper in Tailings" does there seem to be a fixed relation between the efficiency of operations when you figure the oil with and without circulation, or whether you operate with and without circulation and figure the oil accordingly?

A. Well, on March 25th the average per cent. copper in tailings was .241, and on March 26th it was .278.

Q. 191. That is, with circulation?

A. That was with circulation.

Q. 192. At 15 pounds?

A. Yes, approximately, or we endeavored to hold it at 15 pounds. Now, without circulation, on March 27 and March 28 we have .249 and .300 respectively.

Q. 193. What is the difference between these figures such as, to one of your experience would be regarded as involving a substantial difference or as being substantially identical?

A. I cannot see that there is any substantial difference, anything specially noteworthy.

Q. 194. Now, taking March 30th and 31st with the effort—when the effort was to use 10 pounds, and which shows about 10 pounds were used, how do the tailings compare with circulation and without?

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A. On March 30th we used 10.63 pounds of oil per ton without circulation and made a tailing of .589% copper, and on March 31 the total oil inclusive of excess oil from circulation averaged 10.33 pounds per ton in the feed and the average copper in the tailings was .486, which is a little lower than that made without circulation.

Q. 195. About one-tenth of a per cent?

A. Yes.

Q. 196. Now, with your operation, attempting to fix the oil at 5 pounds with and without circulation will you compare the copper in the tailings?

A. On April 1st we ran without circulation, used a total of 5.16 pounds of oil per ton of feed and made an average tailing of .560% copper; on the 2nd of April we used a total of 4.16 pounds of oil per ton treated, which figure includes excess oil from circulation after crediting the dry pulp in circulation with 5 pounds of oil per ton, and an average tailing made that day was 1.277%.

Q. 197. Do you know any facts to explain that rather high tailing with circulation at 5 pounds as compared with the lower tailing without?

A. Why, yes, there is an explanation I think, that will apply there—it certainly does apply, and that is that there was on that day not enough oil to satisfy the mineral in the pulp. There was no oil accumulated from that circulating load. There was not enough oil there to satisfy the mineral. We

had a great deal of difficulty that day. While we aimed at 5 pounds of oil per ton we only got ~~two~~ to 4.16. There was simply not enough oil in the system, in the machine.

Q. 198. Now, what was the general trend of results to the copper loss in tailings as the amount of oil is decreased, in these series of experiments?

A. The tailing went quite constantly upward as the amount of oil per ton was reduced. In fact it went to the point that it represented a great big loss, an enormous loss.

Q. 199. What is the range of figures, just to get them plainly stated outside of this table—loss in tailing?

A. The loss in tailing for that period which we considered a normal period, from December 25th, 1916, to March 24, 1917, the average loss in pounds of copper per ton of tailings, was 2.40 pounds of copper per ton. On March 25th it was 4.82.

Q. 200. With 16 pounds of oil; is that what you mean?

A. Yes, with 16 pounds of oil.

Q. 201. Might as well state the amount so we know what the figure is related to.

A. On March 26th it was 5.56 with 15.84 pounds of oil used. On March 27th it was 4.98 with 16.33 pounds of oil. On March 28th it was 6.00 pounds of copper per ton with 16.41 pounds of oil per ton On March 30th it was 11.78 pounds of copper per

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ton with 10.63 pounds of oil used per ton. On March 31 it was 9.72 pounds of copper per ton with 10.33 pounds of oil per ton used. On April 1st it was 11.20 pounds of copper per ton with 5.16 pounds of oil used per ton, and on April 2nd, it was 25.54 pounds of copper per ton with 4.16 pounds of oil used per ton.

Q. 202. Does that last figure you read, a loss of 25.54 pounds of copper to the ton, represent any recovery at all? What were the headings here, about? —Unless the other side wants it I don't care about the actual figures but I should like to know what kind of material you were treating.

A. Yes. I can give you the actual figures. That was April 2nd.

Q. 203. April 2nd. The test marked "C" with a star.

A. On April 2nd the heading contained 7.14% copper. The tailing as shown on this exhibit 38 was 1.277% copper, and the concentrate 27.09% copper. The indicated extraction for that day was only 86.16%.

Q. 204. Now, do your notes enable you to give the same figures for that normal period or does that already appear in some of the tables we have in evidence?

A. Well, for that normal period—I haven't that figure for the normal period with me, I believe, right now. I can give you though—I can give it to you by months.

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Q. 205. Maybe you can compile it before you come back after recess and then you can give it to us for that whole period just for a basis of comparison. Now, I find a column here "Loss, Pounds of Copper per Ton." That is the column we have been talking about. The next column is, I take it, the loss per ton on 15 cent copper—That is what it says, the value I presume of the copper that is lost in each ton of ore treated.

A. Yes, this first set of figures, the loss per ton at 15, 20, 25 and 30 is the calculated total loss.

Q. 206. The value of the copper that goes into the tailings?

A. Yes, without any comparative—without any comparison being attempted. That is, under our normal period when the average copper in the tailings was .12, the loss in pounds of copper per ton was 2.40. Now, at 15 cents a pound for copper that is 36 cents per ton of tailings, that was lost.

Q. 207. Then I am correct, am I not, that these three columns, "Loss Per ton, 15, 20, 25, 30—four columns, that simply represents the value of metallic copper in the tailings under the different columns represented?

A. Yes.

Q. 208. Now, we have next here "abnormal loss per ton tailings."

A. Abnormal loss, pounds copper per ton tailings.

Q. 209. That is simply the weight of the copper

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in the tailings under those different conditions?

A. No, that is the abnormal loss; that is the difference.

Q. 210. How do you figure the abnormal loss?

A. Why, in this: we consider for that period covered, from December 25th, 1916, to March 24th, 1917, which we have considered a normal period for the purpose of comparison—the pounds of copper there, you will notice, loss in tailings—the pounds of copper per ton is 2.40. The corresponding figure on the next line, which is of date March 25th, is 4.82. Now that is the actual loss, 4.82, so we consider the abnormal loss the difference between that and the average loss of the normal period, which in this case would be 2.42.

Q. 211. The 2.42 in the abnormal loss column is arrived at by taking 2.4 from 4.82?

A. Yes.

Q. 212. Then here in this abnormal loss column, that represents the actual loss under each of these conditions, minus the 2.4 pounds that you consider a normal loss?

A. Yes, sir.

Q. 213. Therefore you have this abnormal loss?

A. Yes, sir.

Q. 214. Then in the next column, you have simply, I take it, computed the value of what you term the abnormal loss at different prices per pound, as stated at the head of the column?

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A. Well, we have computed the abnormal loss per ton under these varying conditions, and at the different prices, and also the abnormal loss per day, which is figured on the actual tonnage of the tailing which went out at that high figure.

Q. 215. Now, give us the range of loss that you mentioned how that figure per day at, will say, fifteen cent copper?

A. The abnormal loss per day at fifteen cent copper on the days on which we endeavored to use fifteen pounds of oil per ton, are as follows: On March 25th we actually used 16.17 pounds, and the abnormal loss is $300.93.

Q. 216. Per day?

A. On that day; that is the actual figure of the amount of tailing which went out with that abnormal amount of copper in it. On March 26th using 15.84 pounds of oil per ton of feed, the abnormal loss was on that day $394.84.

On March 27th, when 16.33 pounds of oil was used per ton of feed, the abnormal loss is $300.70.

On March 28th with 16.41 pounds of oil per ton of feed, the abnormal loss was $404.46.

On March 30th—

Q. 217. Mr. Conrads, you might state whether these losses kept on increasing, or whether they decreased, and what maximum and minimum they finally arrived at?

A. The loss increases almost constantly, with the

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reduction in the amount of oil used per ton of material treated; and on the last test which was conducted on April 2nd with 4.16 pounds of oil per ton of feed, the abnormal loss at 15 cent copper amounts to $2,912.17.

Q. 218. Now what would that amount to at thirty cent copper; just twice as much?

A. At thirty cent copper it would be $5,824.34 abnormal loss for the day.

Q. 219. Did you make such efforts as were possible to get the best results under all the different conditions recorded upon exhibit 38?

A. I did; I made a special effort to see that the best results were obtained that we could possibly obtain under the varying conditions.

Q. 220. What oil mixture did you use that day; does that appear on this tabulation?

A. Yes, I think so.

Q. 221. I don't believe it does.

A. Let us see. That is not on there, but we used a mixture of fifty per cent of Jones oil, 37 1-2 per cent of Lyoth fuel oil.

Q. 222. What is that Lyoth oil?

A. It is a California fuel oil that we receive from Lyoth, California, and we give it that name—and also 12 1-2 per cent of American creosote.

Q. 223. Is that a mixture that you have found suitable for use in operating with over twenty pounds per ton?

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A. That exact mixture we had not used for a very long period.

Q. 224. You have used it on other occasions than during these tests recorded in exhibit 38?

A. We used it on the day before, and one reason for not having used it for a longer period was on account of the difficulty we have had in getting a sufficient amount of Jones oil, that I was never able to work that down to get just exactly the combination that I am perfectly satisfied with, on account of not having ample supply of oil at all times for the purpose.

Q. 225. Do you know any facts to explain the reason these results deteriorated with the decrease of oil, whereas in some of your experience you have obtained good results with small amounts of oil?

A. Yes, we can get good results with small amounts of oil, very much smaller than this, and have done it, but with entirely different oils.

Q. 226. You think it is simply a question of the oil, the quantity to be used?

A. Yes. The conditions with the lower amounts of oil—we have not changed our conditions in the plant; the agitation of the feed, the flow of the pulp, or any of those conditions were not changed. And there is another thing that we never took into account in using the small amount of oil, that is, in that period covered by this exhibit 35—we never did take into account the circulating oil; we have no idea

whether that figure given here is pounds of oil—that figure is pounds of new oil per ton.

Q. 227. As a matter of fact there was circulation in the system at that time?

A. Yes, at all times; that is our regular operation.

Q. 228. What effect would that have upon the amount of oil as stated in exhibit 35?

A. Well, it would increase it; to just exactly what amount it is impossible to say, but it is very probable that in some of those cases it might have gotten up to one per cent, or certainly over half of one per cent, which would be ten or twelve pounds, easily.

WHEREUPON an adjournment was taken until 2:00 P. M., Friday, April 20th, 1917.

Friday, April 20th, 1917, 2:00 P. M.

Q. 229. Mr. Conrads, have you made any observation or do you know any facts that go to show what becomes of the oil what is used in these operations—more particularly with a large amount of oil?

A. I have nothing but my own observations; that is, I have made no definite calculations as to where it goes.

Q. 230. You mean no assays?

A. No assays.

Q. You have made some observations that throw some light on this question?

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A. Yes, I have.

Q. 231. Will you state what they are?

A. Since using the greater amount of oil I have noticed a considerably greater amount of froth which collects in the concentrate bins, or the bins into which the concentrate is run for drying, and from which it is shipped.

Q. 232. The completed concentrate?

A. Yes, the finished concentrate. As to the definite proportion or any assay, I could not say, but from observation I have noticed this froth has accumulated in some cases easily as much as a foot and a half deep on top of the bin.

Q. 233. How deep are these bins?

A. Those bins are fifteen by twenty-two and a half, each bin, in area.

Q. 234. They are that wide and that long?

A. Yes, that is the area of each individual bin; we have sixteen of these bins in service, concrete bins.

Q. 235. And you noticed this in the bins that were receiving concentrate which had large quantities of oil?

A. Well, our flotation concentrate does not go to the bins separately, but it is elevated into the general high grade concentrate launders from the entire plant.

Q. 236. And all the concentrates go together?

A. Yes, they flow on to the concentrate bins, and the distribution of the loading of those bins is simply governed as a matter of convenience, that is as to where the load goes at any particular time, depending on which bins are full, which bins we are loading out

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of and which are empty. Consequently there is an overflow, if the concentrate is going into one bin—before that bin is solid concentrate, there is quite a good deal of water and other material in general which overflows into the succeeding bins, and naturally that accumulates in different places.

Q. 237. And what did you notice in these bins?

A. I remember distinctly at one time I had one of the men that work there try to see if he could ascertain the depth of that froth on the concentrate bins, —on one of the bins, and he did not get to the bottom of it; he reached in probably—I should say to a depth of a foot and a half, at least that.

Q. 238. Did you ever do anything with this froth in the way of examining it or investigating it?

A. Yes, I attempted at one time to see if it would be possible or practicable to attempt the recovery of the oil from it.

Q. 239. How did you know there was oil in it?

A. Well, it is evident that it is a froth from the flotation plant; it is an oil froth; you can see the nature of it; and while there is more or less always, or always has been in my time at the plant—of course, during the period that I have been there they have been using the flotation process on the low grade stuff, and we always have a certain amount of that froth in evidence, but it is so much greater—

Q. 240. How does the quantity of that compare when you are using less than one per cent, say four or five pounds of oil, with the times when you are using twenty pounds?

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A. Well, the amount of froth with the greater amount of oil is greatly increased, there is a great deal more of it. I attempted to see if it were practicable to recover any oil from that, but after accumulating it for at least ten days or two weeks, I don't remember exactly, we attempted to break the froth down and draw the oil from it, and on close observation I could see that it was almost completely filled with very fine solid matter, probably concentrate and perhaps some silica; solid matter, mineral, probably and some fine silica for that matter—but with solid matter. It was very heavy in it, and I took some of that sample and tried to separate it in a centrifuge, a centrifugal machine. I did get some oil separated. These were not quantitative tests, simply observation. I did get some oil separated, and also quite an amount, relatively, of that fine solid matter. As I said before, with the fine mineral and perhaps silicious matter also,—from that the centrifuge would not make the separation, that is, separate out the solid matter from the oil.

Q. 241. Well, the liquid in which the solid matter was contained—was that all oil or was it oil and water or what?

A. Well, that had some water in it.

Q. 242. What?

A. That had some water in it. This froth itself, in taking a small sample like that, you naturally get some water with it.

Q. 243. Were you able to observe with certainty that there was oil present in the liquid which was separate from this froth which you spoke of?

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A. From the experiment with the centrifuge?

Q. 244. Yes.

A. Yes, sir.

Q. 245. Have you ever made any observations with regard to the effectiveness of the different oils which you have used in this mixture?

A. The general characteristics of the oils?

Q. 246. Their characteristics and their effectiveness in contributing to the result.

A. Yes. We have had that more or less forced upon us in failure to obtain sufficient supplies of oil that we would select in combination. For instance, we use generally, Jones oil, we use in our combination quite regularly, but at times our supply has been completely exhausted and we have been forced to use what oils we had on hand. For instance, that fuel oil, the Lyoth fuel oil, I have used that entirely alone; I have used it in combination with American creosote and I have used various proportions of Jones oil, Lyoth fuel oil and American creosote and I have used also combinations of Jones oil and Yaryan pine, small amounts of Yaryan pine as a frothing agent as the Jones oil has not sufficient frothing qualities.

Q. 247. Have you statements showing the results for individual days, separate from the time you began to use large quantities of oil?

A. Yes, sir.

Q. 248. I wish you would produce such statements.

(Witness produced the statements.)

Q. 249. These statements cover what months?

A. I have one which covers a period from December 25th to 31st inclusive.

Q. 250. 1916?

A. 1916, yes.

Q. 251. And then what months in 1917?

A. The entire months of January and February and March and the month of April, from the first to the seventh inclusive.

Q. 252. These statements contain the data from which the summary statements that we have already had before us were compiled, do they not?

A. From which that monthly summary was compiled, yes, sir.

Q. 253. That really covers the same ground does it not?

A. Yes, sir.

Q. 254. Except that, naturally, they exhibit each day separate instead of in monthly summary?

A. Yes, sir.

Q. 255. So that what you have stated about the other exhibits containing the monthly statement, with regard to your having charge of the operations, will apply equally to these statements?

A. Absolutely, yes, sir.

Q. 256. And you therefore know them to be correct in the same sense that you knew the other ones to be correct?

A. Exactly.

MR. SCOTT: I will then offer in evidence these statements, showing the results by days, the first en-

titled "Utah Copper Company, Magna Plant, Metallurgical Department, Composite Flotation Retreatment Plant Results, December 25th to 31st, 1916, inclusive."

MR. GARRISON: Our standing objection, if your honor please.

THE COURT: Very well, overruled.

The statement is admitted in evidence and marked DEFENDANT'S EXHIBIT 39.

MR. SCOTT: The next one entitled, "Utah Copper Company, Magna Plant, Metallurgical Department, Composite Flotation Retreatment Plant Results, Month of January, 1917."

MR. GARRISON: The standing objection.

THE COURT: Overruled.

The document was admitted in evidence and marked DEFENDANT'S EXHIBIT 40.

MR. SCOTT: The next one entitled "Utah Copper Company, Magna Plant, Metallurgical Department, Composite Flotation Plant Results, Month of February, 1917."

MR. GARRISON: The same objection.

THE COURT: Overruled

The statement was admitted in evidence and marked DEFENDANT'S EXHIBIT NO. 41.

MR. SCOTT: The next one is entitled: "Utah Copper Company, Magna Plant, Metallurgical Department, Composite Flotation Retreatment Plant Results, Month of March, 1917."

MR. GARRISON: Same objection.

THE COURT: Overruled.

The statement was admitted in evidence and marked DEFENDANT'S EXHIBIT 42.

MR. SCOTT: The next one is entitled "Utah Copper Company, Magna Plant, Metallurgical Department, Flotation Retreatment Plant Results, for the Period April 1 and 7, 1917, Inclusive.

MR. GARRISON: The same objection.

THE COURT: Overruled.

The statement was admitted in evidence and marked DEFENDANT'S EXHIBIT No. 43.

MR. SCOTT: On these reports I will state that we only have two copies, but will have more made this evening, as soon as court adjourns, to supply the other side.

MR. GARRISON: Is there anything we can follow in the examination of the witness.

MR. SCOTT: I am not going to examine him any further about them, except to find out if the same general plan was followed in the preparation of these statements as was followed in the monthly summary.

Q. 257. The same general plan was followed in compiling these daily statements as was followed in the monthly ones, was it not?

A. The same general plan, yes.

Q. 258. The only essential difference is that the data is set forth in 24 hour periods instead of averages for the month, is it not?

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A. Yes, sir. There is a further slight difference, about the only difference that I recall right now, between these various statements is that from December 25, 1916, to January 16, 1917, inclusive, no oil was credited from circulation. There was a circulating load carried but it was not taken into account. From January 17th to March 3d, inclusive, that circulating oil was taken as new oil.

Q. 259. Without making any allowance for the increased tonnage due to the solids in the middlings?

A. Yes, sir. From March 4 to 24 inclusive the circulating oil in excess of 20 pounds per ton of dry pulp in circulation was credited as new oil. Then immediately following that comes a period of these tests with various amounts of oil.

Q. 260. These are the tests upon the abnormal costs statement?

A. Yes, in which that is specified, when we credit as 15 pounds and 10 and 5, respectively.

Q. 261. And this brings the report down to the end of the period?

A. The report down to April 7th.

Q. 262. Mr. Conrads, before you leave the stand you might detach from your book the copy of these exhibits so that counsel for the other side may have them to look at while cross examining you. You have copies of them in that book?

A. I have the copies, but I will have nothing to refer to.

MR. GARRISON: Has he copies besides these?

THE WITNESS: I have my own file copy.

Ralph Augustus Conrads.

CROSS EXAMINATION

BY MR. WILLIAMS:

X-Q. 263. Going back to the operations from August 1915, to and including December 24, 1916, I do not observe that the table, exhibit 35, gives any information as to the oils that were used. Can you supply that information generally?

A. I can suppply it in detail, Mr. Williams, by reference to my notes—that is, I think I have quite sufficient detail.

X-Q. 264. It wouldn't be a very long matter, would it?

A. If you care to refer to it by days. I haven't the monthly statement made up of the various days of the months, you see, comparison by a month, but I can get that data for you on any particular day or days.

MR. GARRISON: You can make out a table for us and furnish it to us, can't you?

A. I can, but it will require quite a great deal of time.

MR. GARRISON: It would require infinitely more time if we ask you question by question, day by day?

MR. SCOTT: Will the stenographer please read the question?

(Question read as follows: "Going back to the operations from August, 1915 to and including December 24, 1916, I do not observe that the table, exhibit 35, gives any information as to the oils that were used. Can you supply that information generally? A. I can

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supply it in detail, Mr. Williams, by reference to my notes—that is, I think I have quite sufficient detail. Q. It wouldn't be a very long matter, would it.")

X-Q. 265. Were frequent changes in the oil used during that period, or was there a comparative stability?

A. Generally a comparative stability. There were changes and trials of new combinations, etc., at times.

X-Q. 266. Well, what in general were the oils that you used during that period?

A. That is referring to the period subsequent to August?

X-Q. 267. From August, 1915, when you went to the plant, up to December 24th, 1916, when you changed to large quantities of oil?

A. I have this in a manner here which I think will go over that as you desire, Mr. Williams. In the month of August, 1915, Barrett creosote, Barrett No. 4, Jones oil, pine oil and No. 642—that is reconstructed pine oil. That was used on the first of the month.

X-Q. 268. In what proportions?

A. We used 520 pounds of Barrett creosote, 645 pounds of Barrett No. 4, 778 pounds of Jones oil, 197 pounds of pine oil, and 333 pounds of No. 642.

X-Q. 269. That was the total for the month?

A. No, that was the first day of August.

X-Q. 270. That was the total amount of oil used on that day?

A. On that day.

X-Q. 271. Now what was the total tonnage of material treated on that day?

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A. On that day we treated for one section 224 tons. and for the other 324 tons, total 548 tons.

X-Q. 272. Now, give me another typical day?

A. We changed them to Barrett creosote, Jones and pine oil on the second, and Barrett creosote, Jones and pine and No. 642 on the 3rd and 4th. There is a period from the 16th to the 31st we used Barrett No. 4, Lewis creosote, Jones oil, pine oil and No. 642.

X-Q. 273. Give me the proportions on that day, first of the oil and then of the material, say the 24th?

A. August 24th we used 431 pounds of Barrett No. 4, 949 pounds of Jones, 319 pounds of Lewis, 291 pounds of pine, 555 pounds of No. 642.

X-Q. 274. What tonnage did you treat on that day?

A. The tonnage for one section was 226 and for the other 322; that makes 548 total.

X-Q. 275. Now, can you run along and tell when any very substantial change was made?

A. Take the month of September I think we used the same combination.

X-Q. 276. Then never mind.

A. That was used from the first to the 6th, the 21st to the 24th, and the 28th to the 30th.

X-Q. 277. Then in October was there any substantial change?

A. It is essentially the same, Mr. Williams; we used Jones, Lewis Creo, Barrett 4 and 642.

X-Q. 278. Then we will run along in 1916 and take it about the middle of 1916 and see what you were using?

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A. When would you like?

X-Q. 279. August, 1916, if you were running regularly then?

A. Yes. In August, 1916, we used Jones oil, American creosote, and Weaste, which is another creosote oil, and the trade name that we received it under is Weaste. That was used from the 1st to the 10th inclusive.

X-Q. 280. And the amount for each day?

A. What day would you like; that was used from the 1st to the 10th.

X-Q. 281. Say the 5th?

A. On the 5th we used 2000 pounds of Jones oil, 666 pounds of American creosote and 666 pounds of Weaste oil.

X-Q. 282. And the tonnage of material treated on that day?

A. The tonnage was 935 tons of heading.

X-Q. 283. Total?

A. Yes.

X-Q. 284. Now, suppose we come back to December 24th, the last day of the series. There was no change made then; you were running regularly then, about as you had before?

A. There were changes at times; as I said before we have not been able at all times—that is, we have changed our combinations according to the various oils. We have used, for instance, Barrett No. 4, Weaste and Jones, and we have used Lewis creosote and Jones oil and so forth, such things as that.

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X-Q. 285. I see that the average for the month in pounds of oil per ton, for the month of December is 3.83, and let us see now if on the last day, December 24th, you were running about the average; you were not getting ready for the change or anything like that?

A. Well, on December 24th we started to use the increased amount in the afternoon, and the only reason that it was not included here is because the 25th was the first entire day that we used the increased amount.

X-Q. 286. Then you had better take about the 15th of December?

A. All right, sir. On the 15th of December, 1916, we used 1922 pounds of Jones oil, 1704 pounds of American creosote, making a total of 3626 pounds, and we treated 970 tons.

X-Q. 287. Now, when, in December, commencing on the 25th, did you settle down to normal conditions. You started to use this large amount of oil, and of course I assume it took you a little while to get the plant settled; about when did that happen?

A. Well, it was not so much getting the plant settled, Mr. Williams, as it was being able to gauge that increased flow of oil accurately; that was the particular difficulty. It was about the 30th when we got that sufficiently under control to be able to hold it as closely, or fairly closely to what we wanted.

X-Q. 288. I see that on the 31st of December your original feed was 20.72 pounds to the ton; is that right?

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A. That is right.

X-Q. 289. Now I would like you to give me the amount of the respective oils; you have given their percentages in the table, but give me the amount of oil that you fed on that day, as to the respective oils?

A. On that day we used 14,806 pounds of Jones oil, and 779 pounds of Yaryan pine.

X-Q. 290. And on that day you used 11 cells; what does that mean; did you use 11 circulating cells? You say "the number of cells circulating."

A. By referring to the diagram you will see that that means that 5 cells were producing finished concentrates, and 11 were producing middlings, which were returned to the circulating feed.

X-Q. 291. Now, on that day, this 20.72 pounds per ton was the original feed of oil, was it?

A. Yes, sir, that is new oil per ton.

X-Q. 292. And does this table show what you have spoken of as the circulating oil?

A. No, sir, it does not. If you remember, I mentioned that during this period we took no account of the circulating oil.

X-Q. 293. Now, when will I find a day when you took account of the circulating oil?

A. Just refer to your month of January please.

X-Q. 294. Somewhere about the middle of January, is that right?

A. January 17th.

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X-Q. 295. Was the plant running continuously from January 17th on to the end of the month?

A. Yes.

X-Q. 296. You did not stop to make any experiments or you did not alter the condition, you were running on normal conditions?

A. Yes. Now we had circulation before that; we had actually a circulating load, but we did not take it into account and we did not determine the amount of oil; that was not any change in operation, it was simply a change in the method of accounting, and accounting for that circulating oil, which had not been taken into account before.

X-Q. 297. Now, will you mark on your sketch the point at which you took out the material for the purpose of getting the measurement of that circulating oil; just mark it on your sketch, exhibit 37?

A. Right here, where we took the sample from which is determined the oil in circulation; that is, the oil which is returned in that circulating load.

X-Q. 298. That is somewhere in the sludge tank?

A. No, sir; the launder comes in above the sludge tank, right above it, and empties directly into it, and we got our sample right at this point, at the mouth of that launder.

X-Q. 299. That is, before the launder dumps its load into the tank?

A. No, as the material leaves the launder going into the tank, we cut the stream where it is entirely

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free from the launder. We do not take it in the launder.

X-Q. 300. That is you take it as it is falling down from the launder to the tank?

A. As it is discharged into the tank. We take our sample there for the percentage of oil, and for the percentage of solids in the feed. Now, as a matter of convenience we take the feed—that is the tonnage sample of the circulating feed—before it gets here, because it is really a very inconvenient place to get on top of that tank and take it, so we plug or shut off the feed there.

X-Q. 301. In the launder?

A. In the launder.

X-Q. 302. That is before it enters the tank?

A. We put a gate in the launder, and we have a six inch hole, and we allow that to run until the full flow is carried, and we have been sure to see that that hole is made large enough that there will be no retarding, that it is ample to take the entire flow, and we let that run until the stream is steady and we see there is no accumulation in the launder, then we take a time sample, taking the entire feed, and we weigh that, and that gives us the total weight of the sample, of course, for a given definite period. We get our solid sample here, indicating the sample to determine the percentage of solids, and the percentage of solids is derived from that sample, from that we calculate the tonnage of feed for twenty-four

hours, knowing the total amount of feed for a given length of time.

X-Q. 303. Will you mark an "A" at the point where you measure your tonnage?

A. Of the circulating load. How would it be to put a cross there and indicate on the side?

X-Q. 304. Put an "X" at the point in the launder and run a leader from it outside?

A. Now how do I mark it?

X-Q. 305. Mark it with a big "A." Now, the other point that you have described is simply the overflow, the water falls from the launder?

A. It is simply the stream after leaving the mouth of the launder as it discharges into the sludge tank.

X-Q. 306. That sludge tank is it ever full to overflowing?

A. No, I have never seen the sludge tank full; that is, it is perfectly clean, a clean fall; that is, it does not interfere in getting the sample.

X-Q. 307. And how deep is the sludge tank, about?

A. The sludge tank is—I will tell you exactly in a minute. Eight feet diameter by ten feet deep.

X-Q. 308. What is it that maintains in the tank a circulation such as prevents sediments?

A. There is a continuous discharge from the bottom of the tank, the flow going in at the top, the discharge being drawn off from the bottom, I should say, would prevent that as much as anything else.

X-Q. 309. You do not have any stirrers of any kind inside of the sludge tank?

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A. No. There was at one time some air pipes put in simply to prevent any accumulation there, but that doesn't bother any, any accumulation of sediment in the bottom of the sludge tank.

X-Q. 310. Now, what goes into that sludge tank is the new feed and the return middlings?

A. The circulating load from the return cells.

X-Q. 311. And the new feed?

A. And the new feed, yes, sir.

X-Q. 312. Nothing else goes into it?

A. No, sir.

X-Q. 313. And what comes out of it is what?

A. Just exactly what goes into it.

X-Q. 314. Well, is it the feed of the flotation plant?

A. Yes; yes, sir.

X-Q. 315. That is to say, everything that goes in there, goes out into the feed of the flotation plant?

A. Yes. There is the new, original feed coming in; there is the circulating load coming at another launder. From the bottom we tap that mixture of new feed and circulating load.

X-Q. 316. What is your habit as to taking these samples out; how frequently during the day and for what period?

A. These samples are taken at hourly intervals, regularly.

X-Q. 317. And for how long a period?

A. They are taken for a period depending on the amount of the flow. We have a large tub into

which we tap that sample. When that return flow is extremely heavy we can not get it for quite as long a time as when it is a lighter flow. Our endeavor is to get as large a sample as possible. Generally speaking, though, we will take a 15 second sample, sometimes a 20.

X-Q. 318. Is it an automatic sampler?

A. No; no, sir.

X-Q. 319. A man times it, or a boy?

A. As I explained to you, we plug that launder; we put a gate in the launder to stop the flow, and at the same time pull the plug from the hole in the bottom of the launder, which, by the way, is very close to this gate so that there can be no accumulation in the same; the hole is amply large to take the full flow and we allow that to run until we are quite sure that the normal flow is coming, and then we cut our tub under and there is a stop watch to take the exact time.

X-Q. 320. Now what does that circulating load consist of?

A. The circulating load consists of the material that is overflowed from the Spitzkastens of the cells which are not producing a finished concentrate.

X-Q. 321. That is the froth?

A. Froth and more or less of the pulp and water.

X-Q. 322. That is to say, your overflow is such a free overflow that water goes with the froth?

A. We have froth removers pulling that over, and

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in pulling that froth there is a certain amount of water accompanies the pulp.

X-Q. 323. And that is the material which is in this circulating load, the froth, the water, and whatever goes with it as an overflow through these machines?

A. That overflow is run over from those cells which are not making a finished concentrate.

X-Q. 324. Take January 26th. On that day you computed as your total pounds of oil per ton, 20.17, while the oil that you fed into the plant was 14.32 pounds per ton. Is that right?

A. That is the figure which appears. I am quite sure it is right.

X-Q. 325. Now, as I understand what these figures represent is the material that flows from the sludge tank into the flotation plant head added to it, just after it left the sludge tank?

A. Oil in the proportion of 14.32 pounds per ton.

X-Q. 326. The dry material is the pulp; is that right?

A. Of dry material in the original feed.

X-Q. 327. And that dry material fed to the plant was 1003 tons, is that right?

A. On the 26th?

X-Q. 328. On the 26th?

A. I so have it, yes.

X-Q. 329. So that on that day you fed into the

plant 1003 dry tons of material to be treated and you fed into the plant oil at the rate of 14.32 pounds to the ton of that material and according to your computation the pulp that went into the flotation machine contained 20.17 pounds of oil to the ton of dry material that went into the flotation machine?

A. To the ton of dry material of the original feed, not including any tonnage or solid material which was returned in the circulating load.

X-Q. 330. Which, of course, would have reduced that?

A. Yes, sir.

X-Q. 331. That is to say, in this calculation you do not take into account all dry material that came around in the circulating load?

A. No, as explained before, Mr. Williams, this is a period during which we did not take into account the dry material, nor attempt to satisfy that with oil, in the circulating load.

X-Q. 332. Well, now, let's get into some time when you did all of that, had all of your refinements.

A. I beg your pardon, Mr. Williams, just a minute. You asked me to mark this exhibit No. 37, which I did, with the point indicated where we take that tonnage sample, and I have indicated here with the letter "A." Now you wished another indication there where we took the sample for determining the percentage of solids.

X-Q. 333. I think your sketch sufficiently indicates

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the end of the launder, but if you will just draw a line across it, then your description that you took it as it overflowed into the tank, is sufficient.

A. All right, sir.

X-Q. 334. Now where will we find a computation in which you had all your refinements of calculation?

A. You will find that from the 4th of March on.

X-Q. 335. Take March 19.

A. Yes, sir.

X-Q. 336. On that day, according to the showing of your table, exhibit 42, the total pounds of oil per ton entering the flotation machine was 20.27; is that right?

A. Yes, sir.

X-Q. 337. And that is the pounds per ton in relation to all of the new material that went into the flotation machine; is that right?

A. That is on what day, Mr. Williams, please?

X-Q. 338. March 19th.

A. That is the total pounds of oil per ton of original feed, after satisfying the dry tonnage in the circulating load with 20 pounds of oil per ton.

X-Q. 339. Therefore, according to your calculation a portion slightly in excess of 20 pounds of oil to the ton of material entered the flotation machines; is that right?

A. As I explained, there was 20 pounds of oil per ton allowed from the amount of oil in the circulating feed, 20 pounds of that oil per ton of the dry

pulp contained in the circulating feed. The balance we considered excess oil.

X-Q. 340. Well, let us find out how much oil there was per ton of material in the circulating feed; does your table show that in one of the numerous columns?

A. I think we can find that in one of the numerous columns.

X-Q. 341. I find the figure 66.23 which seems to be under that heading, "Pounds Oil Per Ton in Circulation." Is that is, under the general heading "Circulation Feed"?

A. Yes.

X-Q. 342. That is circulation feed?

A. Yes, sir.

X-Q. 343. That material?

A. Yes.

X-Q. 344. Concentrate not rich enough to take away. Contained 66.23 pounds of oil per ton of material?

A. Dry material.

X-Q. 345. Of dry material?

A. Yes, sir.

X-Q. 346. And pounds of new oil per ton of original feed was 12.38?

A. Yes, sir.

X-Q. 347. Now, assuming that the pulp which flowed into the flotation machine contained material which was a mixture of mineral and gangue and con-

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tained oil and the relationship between the two was such that there were 20.27 pounds of oil per ton of new material—

A. (Interrupting) of original feed—excuse me.

X-Q. 348. Well, as I am endeavoring to grasp these figures and I don't live with them, as you do, you were assured, you said, that all the material that went in there, had oil, and amount of oil with it, that there was a proportion of 20 pounds and a little more, per ton of material. That, you said, you were sure of.

A. Let me, if you will—Perhaps if I can explain and clarify the matter,—

X-Q. 349. I will be pleased to have you do so.

A. All right, sir, I will endeavor to. You understand what makes up our circulating load.

X-Q. 350. Yes, it is made up of the concentrate that is not good enough to send away, and some water, and of course with the concentrate there is some gangue and with the concentrate there is a great deal of oil, ~~that~~ that is what it is made up of is it not?

A. In general it is the overflow from the Spitzkasten of the cells which are not producing a finished concentrate. Now, we determine the amount of oil in that circulating load. We get that in pounds. We also determine the dry tonnage of pulp in that circulating load. Then multiply the dry tonnage in that circulating load by 20 which gives us the number

of pounds of oil which we must allow for that material which is entering the head of the machine, in addition to the new feed. Now, we have satisfied that with 20 pounds of oil. We then have in this case—generally have—the excess. If we should have a deficit we make that up with new oil. Generally we have a surplus.

X-Q. 351. In figures?

A. In oil.

X-Q. 352. As shown by figures?

A. Certainly, that is the only means we have.

X-Q. 353. It might be speaking ~~to~~ of the concentrates, of course, but you have an excess in figures?

A. We have that oil; we find that out.

X-Q. 354. Yes.

A. We first satisfy the dry tonnage in the circulating feed with its 20 pounds, and the excess—that is added to the total amount of new oil that is put in, and this total amount is divided by the original tonnage of new feed which gives us this figure here.

X-Q. 355. The figure 20.27?

A. Whatever that is—20.27.

X-Q. 356. Is this excess free oil?

A. Now you have asked me a question which I am sure that I can not say.

X-Q. 357. Well, you don't know?

A. We know that that~~'s~~ is oil—We determine that and find that the oil is in there, but as to just what condition it all is, or how much enters—how much of

it is free, how much of it is emulsified in the pulp, how much of it is coating mineral substances, that I can not say.

X-Q. 358. Wouldn't your analysis enable you to detect that, if you took this material and separated the water?

A. There might be a determination of that made. We have not made it.

X-Q. 359. You have not made any determination of it?

A. No, sir.

X-Q. 359½. The oil might be all adhered to the concentrate, or the mineral or a part of it attached to the mineral and a part of it running around in the water, or a part of it on the gangue that was there? Is that right?

A. As to what condition it is, Mr. Williams, I do not know. I have never made a determination of the state or condition of it in that circulating feed.

THE COURT: He asks if it could be one of these things he mentions. Could it be, in your opinion?

A. It could be.

X-Q. 360. BY MR. WILLIAMS: Now, all of this oil that goes in with the circulating feed has been through at least as many of the flotation machines as are supplying a concentrate which is taken away? That is true, isn't it?

A. No, not necessarily because it might come off

of the 5th cell and not been through the remaining eleven.

X-Q. 361. My question is: All of this oil has been through at least as many of these machines as are supplying a concentrate, a finished concentrate? That is right, is it not?

A. Yes. It is not taken off until it passes that portion of the machine which is making finished concentrates.

X-Q. 362. You might tell me what number of cells on that day were producing finished concentrates and what number of cells were producing circulating feed, as you call it.

A. That was on the 19th of March, I believe, was it not?

X-Q. 363. Yes, 19th.

A. I have here on my notation on that day's results, "Concentrates from 6, 7, 8, 9 and 10 cells to bins. Product from balance of cells to circulation; tailings to waste."

X-Q. 364. That number that you have there, does that show that machines 1, 2, 3, 4 and 5 were in the circuit or not?

A. What numbering do you refer to?

X-Q. 365. You said 6 to 10 were producing finished concentrates. How about 1 to 6?

A. Well, that is the total number of cells, does not refer to the numbers.

X-Q. 366. That is the total number?

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A. That is the number of cells.

X-Q. 367. One to six?

A. That would be six cells.

X-Q. 368. And one to ten?

A. Would be ten cells.

X-Q. 369. Out of the 16?

A. And that is varied according to the conditions.

X-Q. 370. That is to say, if the observer notices that the froth in No. 7 is not quite as good as it ought to be, he switches it out.

A. That is left to the operator. For instance if he has six cells for a period of time that are making a finished concentrate, conditions change so that the sixth cell is not making a grade of concentrate which in his estimation is sufficiently clean, he cuts in that cell to the circulating load and out of the high grade.

X-Q. 371. So that at some time that day machines 1 to 10 were supplying a finished concentrate?

A. Yes.

X-Q. 372. And the other machines, 11 to 16, were supplying the circulating load?

A. Yes.

X-Q. 373. Now, I thought that your table showed —but perhaps you can supply it—what was the condition of the feed to the first emulsifier of the flotation plant as to the proportion of oil to solids?

A. That would be—I haven't that figure, Mr. Williams. That would be the total tonnage—that is, the

average proportion would be the total tonnage of that day which was 1031, was it not?

X-Q. 374. Yes.

A. That would be 1031 tons of new feed with 20.27 pounds of oil per ton, plus the dry tonnage in circulation, 176 tons, with its oil at 20 ponnds per ton. We don't carry that figure in that way.

X-Q. 375. I would just like to have that figure. It doesn't seem to me it is a very difficult calculation.

A. No, I can make it. I believe you will find that is right, if I have not made a mistake, 20.23.

X-Q. 376. Twenty and twenty-three hundredths pounds of oil to the ton of dry material in the feed to the flotation machine which enter the first emulsifier, is that right?

A. Yes.

X-Q. 377. Now that material goes through these three emulsifiers in series and there is no loss of material at all, nothing leaves it, it just goes right through one after the other, is that right?

A. There is nothing discharged from that, that is, except from 1 to 6 in the series.

X-Q. 378. There is no loss of material?

A. No, sir.

X-Q. 379. Nothing taken off?

A. No,, sir.

X-Q. 380. That is, it enters the first flotation machine?

A. Yes, sir.

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X-Q. 381. Now, what takes place in that first flotation machine?

A. The material is agitated in the cell and it rises by the centrifugal force of the propellers and overflows under a light baffle into the Spitzkasten.

X-Q. 382. One on each side?

A. One on each side, yes.

X-Q. 383. And have you given the speed of the rotation?

A. 570 revolutions per minute.

X-Q. 384. And the diameter of the impellers or agitators?

A. The lower impeller I think is 14 1-2 inches exactly.

X-Q. 385. And the upper impeller is a little larger?

A. Twenty inches.

X-Q. 386. And alongside of the lower part of the machine and extending on up to the top of the impeller there are vertical baffles?

A. Yes.

X-Q. 387. So that there is a terrific agitation in that machine?

A. Yes, there is.

X-Q. 388. And the material is thrown out at the top of the machine?

A. Yes.

X-Q. 389. And drops into a sort of launder or chamber?

A. Under the motor. The motor stands on its own base just above that cell, vertically, and in which

this impeller revolves. The material is forced up to the top and overflows into the Spitzkastens on the side.

X-Q. 390. And when it gets into the Spitzkastens what happens the froth, the concentrate bearing froth which accumulates at the top?

A. That is removed by the froth removers, blades.

X-Q. 391. Slowly revolving blades.

A. Paddles that are driven by a revolving shaft

P. 2710, L. 12, insert "and from the spitzkastens" after "Spitzkastens"

moved in the operation of the machine and that is the finished froth of machine No. 1?

A. Yes; the head cells make a finished concentrate.

X-Q. 393. How much oil is removed in that concentrate?

A. I have never determined that.

X-Q. 394. A considerable amount of oil goes with the concentrate there, doesn't there?

A. There is quite a great deal of oil goes with the concentrate.

X-Q. 395. Now, from this first machine you have first an overflow of froth carrying with it a considerable amount of oil, and then you have the tailing, haven't you? which goes into the second machine?

A. Yes, that flows between—that flows through

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the division between the cells it is provided with a gate which is open practically at the point of the bottom of this Spitzkasten, and which is raised and lowered to regulate the flow through the machine.

X-Q. 396. And all the material that that second machine receives is what flows to it as the tailing from the first machine, is that right?

A. Yes.

X-Q. 397. And that material has been denuded of the oil by reason of the fact that the concentrate carrying a great amount of oil has flowed off, isn't that right?

A. Denuded, no, but some, some has been removed.

X-Q. 398. A good deal of it has been removed?

A. There is some removed; there is quite a good deal left.

X-Q. 399. And in fact you have got down now below twenty pounds to the ton of the material treated, haven't you?

A. I have never made a determination of that at that particular part of the machine.

X-Q. 400. In view of the fact that you were so close to the line when you started, 20.23 and in view of the fact that you have taken off a great deal of that oil, it is reasonable to assume that you have lowered now to a condition where you have less than twenty pounds of oil to the ton of material, isn't it?

A. Well, at that point it may be that we have less than twenty pounds to the ton. We have more than

twenty to start with, and that is where we make our calculations.

X-Q. 401. Now, from machine No. 1 we have got this material which has lost some of its oil into machine No. 2. Now, the same thing happens in there as happened in No. 1?

A. The same proceeding, yes.

X-Q. 402. It is only the tailings of machine No. 2 that get into machine No. 3 from No. 2?

A. The tailing from No. 2, or what you might consider the tailing.

X-Q. 403. It is what is left after that concentrate with the considerable amount of oil has overflowed?

A. Yes.

X-Q. 404. And on this day at some time there were ten machines in series, each discharging a considerable amount of concentrate, and a considerable amount of oil, and the amount of oil was being reduced in every step generally; that is right, isn't it?

A. Yes, naturally.

X-Q. 405. Every step down reduces the oil?

A. You know there is a certain amount of oil that goes off with the concentrate from each cell.

X-Q. 406. So that down at machine No. 10, the proportion of oil to dry material must have been very much below twenty pounds to the ton?

A. It probably was, yes. It doubtless was.

X-Q. 407. Then let us take machine No. 11; that would have a still lower amount of oil, and machine No. 11 operated just the same as the others, didn't it?

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A. On the same principle.

X-Q. 408. Only now this concentrate froth was not good enough to use, and it was sent back to be put through the machine again?

A. Yes.

X-Q. 409. An operation that is generally referred to as a cleaning operation, although in this particular instance it may be given a different name, but substantially a cleaning operation.

MR. SCOTT: Are you asking a question, Mr. Williams?

MR. WILLIAMS: I think so; I think that is an interrogation.

A. Well, it might be considered so. We do not regard it as a cleaning operation. Generally in referring to a cleaning operation we refer to a machine which is making—that is, for instance, like our flotation machines are concentrating and cleaning a low grade concentrate.

X-Q. 410. That is, if you put it through another machine you would call it a cleaning operation?

A. Yes, one is called a rougher and another a cleaning machine.

X-Q. 411. But through the same machine you don't call it that?

A. Well, that would be a circulating load, or the term middling is often applied to it.

X-Q. 412. But as a matter of fact that froth was subjected to retreatment in this instance to the same machine head; that froth from No. 11 did not go to

the finished concentrate, but went back and was subjected to retreatment in the same machine?

A. In the same machine, yes.

X-Q. 413. And then from No. 11 to No. 12, you performed the same operation, did you not, still losing a proportion of the oil?

A. Yes.

X-Q. 414. And so when you got down to No. 16, it seems to me that there must have been a very small amount of oil; you agree with that, don't you?

A. There must have been a greatly reduced amount, because there has been a great deal of it removed from the upper cells, or the cells above it.

X-Q. 415. Did you ever measure that?

A. No, sir, I have never determined those figures, except as I have stated in the general circulating load. Of course, you know, measuring that total accumulation from the returning cells.

X-Q. 416. That only gives on this day, as I understand it, an indication of what a large amount of oil is being taken off by the concentrates, doesn't it; it gives us that?

A. Well, you see here that there were 12,768 pounds of new oil added; there were 11,656 pounds of oil in circulation.

X-Q. 417. That is 11,656 pounds were in the rougher concentrates, the low grade concentrates that overflowed from the last machine of the series?

A. It was the froth that was overflowed from the cells which were returning and circulating;—the last machine of the series, yes.

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X-Q. 418. Now, have you got an assay showing the value of the concentrates which was treated as circulating load?

A. An assay of that dry product?

X-Q. 419. Yes.

A. No, I have not.

X-Q. 420. Your only determination was of the amount of oil in it?

A. The percentage of solids, the amount of oil and the tonnage.

(Whereupon a recess was taken.)

X-Q. 421. In this table of proceedings during the month of March, 1917, defendant's exhibit 42, ~~which~~ I observe that there are three days during which all of the 16 cells produced finished concentrate; that is right, is it not?

A. Three days, yes, sir.

X-Q. 422. Of course on those days you did not have any circulating load?

A. None whatever.

X-Q. 423. Now, if the oil in the circulating load is all attached to the concentrates, you would not be adding any oil to the new feed by carrying this circulating load containing concentrates with oil attached to it into the plant, would you?

A. If all of the oil in the circulating feed was attached to sulphide—what is the question?

X-Q. 424. Then you would not be adding any oil

to the new feed by putting in this sulphide with oil attached to it, would you?

A. Yes, indeed. That is still oil, Mr. Williams. Whether it be attached to mineral particles or not, that is still oil, isn't it?

X-Q. 425. Have you any experience upon which you can say that that oil leaves the concentrate or sulphide to which it was attached, and attaches itself to the new and unoiled sulphide that has been fed in there?

A. No, I did not mean to convey that impression; I do not mean to say that. However, whether that oil is all attached to the sulphide particles or not, it is still oil which is returned in that circulating load.

X-Q. 426. Now, in your operations before you changed to twenty pounds or more of oil to the ton, as you have represented it to be, or believe it to be, you did not give any attention to this matter of the circulating feed, did you?

A. As to the calculation or the computation of the amount of oil, no.

X-Q. 427. You never computed it at all?

A. We always carried the circulating load, but as to its entering into our calculations as to the amount of oil which it carried and the amount of tonnage returned or the like of that, that was not computed and did not enter into our calculations. We simply calculated from the original tonnage of new feed and new oil.

X-Q. 428. THE COURT: This circulating load, is it ground additionally anywhere in the circuits?

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A. No, sir.

X-Q. 429. What is the object of it anyway?

A. Well, it is a concentrate—that is, it is removed in the same manner that the concentrates are removed from those cells making the finished concentrates.

X-Q. 430. Why doesn't it go out in the first circuit instead of coming back the second time?

A. Well, in the first circuit the first cells are producing a concentrate which is rich in mineral and of sufficient grade so that it can be shipped directly, it is a finished product. Now, we get down to a dividing line, as it were—we get down to a point where that froth will contain silicious matter and probably middling, which is mineral attached to gangue rock.

X-Q. 431. What I mean to ask is why that second time around these sulphides that are in the circulating load are more likely to come out in a finished product than the first time around, or is there any reason?

A. Well, it may be this, that there may be particles in there that are attached to silicious matter, or that might be involved or connected in some way with fine silicia or silicates and go over in that mass, and in that abrasion they probably would clean and become separated, that would be one reason.

X-Q. 432. All right. I wanted to understand if there was any second grinding or anything. I was of the impression that there was not.

A. No, sir, there is not.

X-Q. 433. MR. WILLIAMS: I think, responding to the line of thought of the court, that what actually

occurs is a repetition of the very violent agitation; that is to say, these concentrates that are not good enough, they are sent back in the circulating load to be again subjected to the agitation; that is what they are subjected to?

A. The same series, and they go in back with the fresh oil and into the original condition—that is, back to the head of the machine, and are subjected the second time and perhaps the third time; we cannot tell how many times—to that same operation.

X-Q. 434. Now, these are all Janney machines, aren't they?

A. Yes, the Janney type of machine.

X-Q. 435. Are they of the mechanical type.

A. Yes.

X-Q. 436. And do they include the compressed air chamber?

A. No, we have no air chamber; this is the mechanical type straight.

X-Q. 437. Now, you gave an illustration, an example of a crusher which received a certain amount of material for crushing, and in which there was a provision for the return of the over sized material and sending it back through the crusher. Now, if that was a roll crusher, everything that went through it was necessarly reduced to the distance between the rolls, isn't that right?

A. Well, to the distance between the rolls, but not at which they are set for grinding, because there is a provision in those crushers which allows, for instance,

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if a piece of iron or steel gets in there, that it can go through it, for they give to a certain extent.

X-Q. 438. But the material that is crushed is not supposed to have any operation in separating the crusher rolls, is it?

A. There is a spring which allows—by which that is taken care of, which is provided for that reason.

X-Q. 439. In that example all of this material, this over size which is sent back and through the rolls again, is material that has been already crushed, although not crushed as fine as desirable?

A. It has not been crushed down to the size that is wanted, and it is not necessarily—naturally you would suppose that the greater percentage of it has been crushed, but there is a possibility that in its original form, if there were some small particles there that were over size from the standpoint of the screen or the size required to be crushed to—there might be particles which go down in that stream and pass through without being crushed. Of course the majority of it would be crushed to a greater or less degree.

X-Q. 440. Well, now, in this example you take a crusher that I think crushes ten—

A. You take a specific example?

X-Q. 441. I think I said 100 tons. 100 tons

P. 2719, After L. 28, insert "A. (interrupting) per day. I don't remember I"

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A. Its original feed is 100 tons per day.

X-Q. 443. And the material that it crushes is 100 tons of material per day isn't it?

~~A. (Interrupting) per day. I don't remember—I~~

A. It crushes very much more than 100 tons of material per day.

X-Q. 444. Well, what does it discharge, 100 tons per day?

A. It discharges more than that; it discharges that originally, also the circulating load.

X-Q. 445. Plus that portion of the circulating load that is discharged on that day; is that right?

A. No, not technically speaking. That is, that is not exactly the point. It receives 100 tons of material, is put in, of ore. The screening plant, under balanced conditions, that finished product which passes the screen will be 100 tons per day. That is, if the conditions balance.

X-Q. 446. And balanced conditions are the conditions that are—You adjust to attain, are they not?

A. Certainly.

X-Q. 447. And so, in the flotation machines you would have balanced conditions, or you would be thrown out of balance, isn't that right?

A. We endeavor to keep balanced conditions.

X-Q. 448. Well, don't you have to keep balanced conditions, for any considerable run?

A. You refer directly to the manner of circulation load, and its influence?

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X-Q. 449. Yes.

A. That, Mr. Williams—There is a variation in that. That is, in the amount, as you will see by these sheets, in the amount of dry feed in that circulating load. I have not been able to determine a definite percentage or a definite balance nor have I been able to see if that goes up in tonnage or up in oil or down in either one, that it necessarily upsets us.

X-Q. 450. Well, it doesn't, does it, when you are running normally, you are not upset by any great increment, and increase of oil?

A. Well, I should say that we don't normally have any great increment, that is—or such increment.

X-Q. 451. Now, in regard to these oil determinations that have appeared on your tables. Mr. Janney described a method of determination. Can that be taken as fairly representative of what you use?

A. We do not use exactly the same method of determination.

X-Q. 452. Can you tell me about how you determine the amount of oil?

A. Yes, sir. The sample, which I refer to as being taken at regular intervals for that purpose, is determined by shifts, 8 hour shifts. The pulp is thoroughly mixed and a portion is weighed and placed in an 8 ounce flask. Petroleum ether is added to the flask and the flask is corked and agitated, and after that agitation the flask is allowed to stand for a few minutes until there is a clear separation between the

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solvent and the pulp. Now, the solvent dissolves practically all of the oil and also holds considerable material in suspension. Water is added to the flask to bring up the level, until the solvent and the oil and this mineral which is floating, up, right up into the upper part of the neck of it. That is decanted into a beaker. The beaker is put on a hot plate and the contents allowed to boil for a few minutes. Then it is removed, allowed to settle; there is a sharp, or clear separation noted of this suspended material, and the solvent. The solvent is then decanted through a filter and more petroleum ether is added to the residue remaining in the beaker. It is again boiled, it is allowed to settle and again decanted, and that operation is repeated time after time until the petroleum ether shows no coloration. The solvent is put into a four ounce Erlenmeyer flask, placed on a hot plate and the petroleum ether is driven off. When about three or four c.c. remain the flask is placed in an air bath heated below 200 degrees centigrade—that is, not above 200 degrees centigrade, until the petroleum ether is entirely driven off, and the flask is cooled and weighed. We have had a little difficulty in that way. The grade of petroleum ether which we have received has some very high fractions in it, and that we have corrected by rectifying and taking only the more volatile or lighter portions. We have also used the method of sulphuric ether and when we use that, on account of its low boiling point, we finished the operation

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in a water bath, water heated to about boiling, and we finish the operation finally, after most of the ether is driven off, we disconnect it from the top and insert a tube with warm air and pass it through until it removes the least trace of that ether.

X-Q. 453. That describes all of the oil determination operations?

A. Yes, that is—Then of course calculations are made from the portion which as weighed originally and the amount of oil which is obtained from them, the calculation is made as to the amount in the total circulating feed, etc.

X-Q. 454. Now, you said something about making experiments in a centrifugal machine, the recovery of oil from the concentrates?

A. Yes, sir.

X-Q. 455. Did you get anything of practical value out of it?

A. No, sir.

X-Q. 456. You do not recover any of your oil from concentrates?

A. I made that one attempt and I found that that froth which we collected from the concentrate bins was practically entirely loaded with very fine mineral, and even after making a separation, or as much of a separation as I could, there still remained what was quite apparent in treating in a centrifuge when it would separate out, that very fine material was quite apparent and we decided that it would not be prac-

tical to try to make the separation or recovery of oil in that way.

X-Q. 457. And in no part of your plant do you make any recovery, do you, of the oil that you put in?

A. Recovery, that is separation?

X-Q. 458. Yes.

A. And a clean recovery of oil?

X-Q. 459. Yes.

A. No, sir.

X-Q. 460. That is to say, all the oil that goes into your flotation plant goes out either with the concentrate or with the tailings?

A. Yes, sir.

X-Q. 461. Now, have you made any determination of the amount of oil that goes out with the tailings?

A. No. I referred to that earlier. I have never made any, except just observations on it, but as to a definite determination, I have not.

X-Q. 462. One of the oils that you referred to this morning was reconstructed pine oil. Can you describe that a little better?

A. Well, it is a pine oil which is treated with sulphur and a distillation made in this way, you see with about—I wouldn't say exactly, but I think 5 to 10% by weight of sulphur is added in this treatment.

X-Q. 463. And the oil thus treated is what kind of pine oil?

A. We call it reconstructed pine oil.

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X-Q. 464. I mean the oil that you start with?

A. That is a pine oil.

X-Q. 465. Like the Yaryan oil?

A. Yes.

X-Q. 466. Or is it the Yaryan pine?

A. I would not be positive as to whether Yaryan pine—Yes, that I am quite sure has been reconstructed, but it is a similar product.

THE COURT: Do you know how much oil goes through your concentrator?

A. I don't know, that is, I never assayed that. The only thing, as I say, your honor, is from observation only as to the attempted reclamation of it, which was a failure, or found to be impracticable on account of the great amount of fine material carried in this froth, in the difficulty in separating it, or the practical impossibility—at least we decided it was not a commercial possibility or there was no money to be saved or made by it.

X-Q. 467. I notice that in your tables you have a heading, "Reagent, Total Pounds and Pounds per Ton." What is that reagent, or what are those reagents?

A. That reagent is one which we make up at the plant of sulphur and caustic soda and lime and water.

X-Q. 468. Did you hear Mr. Janney's description of that and its characteristics, which he gave yesterday?

A. Yes, sir, I was here when he described it.

X-Q. 469. And that is the material which you are talking of?

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A. We make it ourselves and it differs in strength from what is made at the Arthur plant. We don't make it in exactly the same proportion.

X-Q. 470. Did you use that reagent prior to December 24th?

A. 1916?

X-Q. 471. 1916.

A. Oh, yes, yes we have used that at all of the time that I have been at the plant.

X-Q. 472. Don't you give that a name, that reagent?

A. We call it Calura.

X-Q. 473. Do your tables show the proportion of solids to water, or pulp?

A. As it enters the machine?

X-Q. 474. Yes.

A. Yes, sir.

X-Q. 475. Then your tables show that?

A. I am quite sure that every one does; I think so. I guess it is not on this one.

X-Q. 476. Have you any general practice?

A. I can give you that—I thought it was on these sheets.

X-Q. 477. Well, have you any general practice?

A. I can give you the exact figures by months or over long periods. Referring to exhibit No. 35 the percentage of solids for that entire period averaged 36.001. On exhibit 36, covering the period from December 25th, 1916, to April 7, 1917, inclusive, the average percent. of solid was 31.276.

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X-Q. 478. Now, I asked Mr. Janney for specimens of the various oils and he is going to get them. Can you supplement his work by seeing that we are supplied with specimens of the oils that you have used?

A. I can.

X-Q. 479. Would you be willing to do so?

A. Oh, yes, I am perfectly willing to do so, Mr. Williams, the only thing is that I am not sure that we can get specimens of all the oils that we have used at the plant. Now, with that exception only. As to the oils that we have recently used, of course we have them and I will be very glad to get them for you.

X-Q. 480. The ore at your plant is not the same as at the Arthur plant is it—is it or is it not?

A. It comes from the same mine.

X-Q. 481. Comes from the same mine?

A. Same property, yes.

X-Q. 482. So that the specimen that Mr. Janney will give will give substantially the same thing?

A. I should think that they would be all that would be needed. Of course our ore does not assay the same on any particular day. There are certain variations, but it comes from the same mine, the same property and is essentially the same thing.

MR. GARRISON: There is no purpose of sending some to Magna and other to Arthur—that would be a mere chance?

A. To my knowledge there is practically no difference. There is a certain variation of course but then it is essentially the same ore.

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MR. WILLIAMS: Subject to the reservation that I have made before, the cross examination of this witness is suspended.

REDIRECT EXAMINATION.

BY MR. SCOTT:

R-Q. 483. Mr. Conrads, why is it that you now take account of the circulating oil?

A. The circuaiting oil as I look at it, is a factor which should be considered because that is an oil entering the head of the machine. In order to determine your exact proportions you should have that.

R-Q. 484. The exact proportion of oil present in the apparatus?

A. Yes. Of oil to the solids entering the machine. Formerly, as I stated before, we took no account of this although it was present. Now that really gives an erroneous condition. We have a certain amount of new oil but that is not the total amount of oil entering the head of the machine.

R-Q. 485. That is, this statement of operations down to December 24, 1916, the statement of the amount of oil added is an understatement or overstatement of the actual amount of oil present in the process?

A. That would be under at all times. The circulating load will always carry some oil, and as I stated, I believe this morning, that that might be—it is hard to say just exactly what that would amount to, but we have had our circulating oil built up to pass the amount

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or even more than that, of the new oil, so that that figure is, I should say, considerably under the total amount of oil entering the head of the machine.

R-Q. 486. Are you acquainted with any facts that would explain why it is that in the later cells of the series you are not able to get off a marketable or at least to get good concentrate, while in the first cell you do?

A. There may be a number of factors entering into that. There are several possibilities or easy possibilities. There may be a considerable amount of free mineral which is more or less protected from oils, either by an oxidized film, a partial oxidization of these particles, or it may be some envelope or protection by free silicious material, for instance, that it would not be cleaned and that the consecutive operations, the grinding and abrasion in passing through the cells and the continuous agitation would tend to free them, or brighten up the surface of it, free it from any protecting envelope of silicious material, for instance, or an oxidized coating, and eventually make it susceptible or wetable as sulphide.

R-Q. 487. In the operation of other concentrating apparatus, such as the tables and vanners etc., is there anything analogous to the circulating load in your flotation machine?

A. There is a practice—It is not universally adopted, but there is a practice which is used in some places of returning a middling product from a concentrating table directly back onto the table. That is, your fin-

ished concentrate is delivered to its launder. The middling streak or portion as it comes from the table is laundered to some sort of an elevator which will elevate it to return it to be fed over again to the same table. Now, we have a circulating condition in connection with our retreatment plant. There is a middling product from the tables, and also the tailings from the tables which treat the first, second and third spigots of the retreatment plant classifier. That tailing is retreated in vanners. The vanners do not make a finished concentrate. They make a finished tailing and this concentrate is returned in back to the general low grade, and goes through the circuit again. There is very commonly that middling product, or that product which is between a finished tailing or a finished concentrate which must be taken—which must be circulated and taken care of.

R-Q. 488. Did you make any of these later assays yourself personally?

A. Personally I do not.

R-Q. 489. Are you a chemist qualified to do such things?

A. Well, my work has been such, Mr. Scott, that I have not had time to do it, and I have gotten out of it.

R-Q. 490. Where did you get this information which you read upon cross examination regarding the method of the oil determination?

A. That is our method as we use it at the Magna plant.

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R-Q. 491. Originated or practiced by your oil chemist?

A. Yes. That is a thing—while I don't run the assays for the oil I have the supervision of that and the dictation, and I have to go into those details and pass upon those things.

R-Q. 492. As I have understood your testimony it is your universal practice to get your finished concentrate solely from the first cells of the series where the maximum oil is present?

A. Yes; our finished concentrate comes entirely from the first cells of the series.

R-Q. 493. And the lower members of the series, where, if anywhere, the oil supply is depleted, is where you get the middling from which is returned to the head of the machine?

A. Yes; the oil is in much less quantity there from the fact that a great deal of it has been removed with the concentrate from the upper cells, the first cells.

WITNESS EXCUSED.

EDWARD W. ENGLEMAN, called as a witness in behalf of the defendant, being first duly sworn, testified as follows:

DIRECT EXAMINATION,

BY MR. SCOTT:

Q. 1. State your full name?

A. Edward William Engleman.

Q. 2. What is your occupation?

A. Flotation foreman, Ray Consolidated Copper Company.

Q. 3. How long have you held that position?

A. Three years.

Q. 4. Have you had experience in metallurgical work prior to your engagement by the Ray Consolidated?

A. I did.

Q. 5. You might briefly state your education and experience?

A. You mean college course and everything?

Q. 6. Yes.

A. I graduated from the Missouri School of Mines in 1911, with the degree of mining engineer, and spent two and a half years with the Utah Copper Company at Garfield, Utah, in their experimental department, and spent practically half a year with the Butte Dary Musu Mining Company, as mill superintendent in Deer Lodge, and the last three years I have been down at the Ray Consolidated Copper Company as flotation foreman.

Edward W. Engleman.

Q. 7. When did you first have experience with flotation concentration?

A. At the Arthur plant of the Utah Copper Company, which was in the latter part—about the middle of the year, I guess, in 1913.

Q. 8. At the Hayden plant of the Ray Consolidated, what sort of material was treated by flotation?

A. We treat what we call the vanner low grade concentrate and the slime vanner tailings.

Q. 9. Are these flotation operations under your direct charge?

A. They are.

Q. 10. You are responsible for the conduct of the flotation department?

A. I am.

Q. 11. In these operations what amounts of oil have you used approximately?

MR. GARRISON: Our standing objection, of course, goes to this testimony.

THE COURT: Yes.

A. That is from the beginning?

Q. 12. From the beginning, yes, in a general way?

A. Well, the last quarter—well, we started flotation operations on a commercial scale at the Ray Consolidated plant about the first of October, 1914. That quarter we used 4.31 pounds of oil per ton. In 1915 for the total year we used 4.41 pounds of oil per ton. In 1916 for the total year we used 3.36 pounds per ton. In 1917, beginning January 1st, and

Edward W. Engleman.

for the month of January, we used 20.02, for February 18.77, and for March, 21.19.

Q. 13. Have you a statement setting for th the details of these flotation operations during the period you have referred to?

A. Why, you mean the period of 1917?

Q. 14. I mean from 1914 down to 1917, in March?

A. Yes, I have a quarterly report.

Q. 15. Does your statement represent operations carried on under your direction and supervision?

A. Yes, sir.

Q. 16. And you have knowledge of its correctness?

A. Yes, sir.

Q. 17. The operations were conducted, were they, and the figures compiled in the regular course of business at the Ray Consolidated Company?

A. They were.

MR. SCOTT: I will now offer this report in evidence that the witness speaks of.

Report marked DEFENDANT'S EXHIBIT 44 for identification.

MR. GARRISON: Are you going to supplement this with details, Mr. Scott, of the daily operations?

MR. SCOTT: He has some further details that he has not tabulated. I think he can answer as to them.

Edward W. Engleman.

BY MR. GARRISON:

Q. 18. Did you prepare this actual table that you have here?

A. It was prepared under my supervision.

Q. 19. Did you dictate the contents?

A. No.

Q. 20. Who did?

A. The statistician does all the compiling of results that we obtain.

Q. 21. Did you furnish him with the figures?

A. No.

MR. GARRISON: I don't see how this paper is relevant at all or competent.

A. Because all these figures—

MR. GARRISON: I was speaking to the court. This witness says that he did not prepare this but that it was done by the statistician.

BY MR. SCOTT:

Q. 22. The work was compiled under your supervision, was it not?

A. Absolutely.

Q. 23. Everything was done under your direction, both in the practical operation and in the clerical work of compiling the record?

A. Yes, sir.

MR. SCOTT: It appears that this report was compiled in the way that all reports of this kind necessarily are.

THE COURT: It looks so.

Edward W. Engleman.

BY MR. GARRISON:

Q. 24. Where did the statistician get the material he used, if you did not furnish it to him?

A. He got it from the foremen that were working for me at the flotation plant. They report each day and furnish the results.

Q. 25. Furnish them to you or to him?

A. They furnish them to me, and I furnish them to him.

Q. 26. Have you the original material all here?

A. I have all the original material for 1917? I have not the original material for all these.

Q. 27. Have you the original material for any of these?

A. For the previous—

Q. 28. What have you for these? I use the same term you did?

A. No, I have not.

Q. 29. You have no material here except for the year 1917—original material?

A. Original material.

Q. 30. Will you be able to answer questions from any records with respect to any other year than the year 1917?

A. Yes, sir.

Q. 31. From what source will you get the information to answer those questions?

A. Well, I know that these figures are right.

Q. 32. You misunderstand me. I understand that

this paper is a compilation made up by a statistician from reports in your possession; is that correct?

A. Yes, sir.

Q. 33. You said with respect to the year 1917 that you were equipped here now so that you can consult those original records or copies of them and testify from them; is that correct?

A. I can.

Q. 34. And you say that as to the years previous to that you are not so equipped, is that correct?

A. I haven't the records with me. I can send for them and get them.

Q. 35. Yes. I am not criticising you. I am trying to find out the facts.

MR. GARRISON: I still think this paper is incompetent. It seems to have been made by a statistician from reports that are not here. This gentleman did not make it up, and they are only in lump details anyway.

THE COURT: To what extent does it differ from the others that you have already allowed to go in.

MR. GARRISON: Because the gentleman who made the others said that they made them up, and had the material from which they were made, and they were supplemented in each instance with these daily things that are really useful in cross examination. We cannot cross examine from this.

THE COURT: Was it the testimony as to the other reports that the witness himself made the exhibits from data furnished to him?

MR. GARRISON: Yes, sir.

THE COURT: And in this case the data was furnished, but he did not make the exhibit himself.

MR. GARRISON: Yes, sir.

THE COURT: It is only one step further.

MR. GARRISON: You do not understand my objection, your honor.

THE COURT: I understand, yes. I think possibly you have refrained very much from urging technicalities as to this.

MR. GARRISON: Absolutely, your honor. We do not want to stand on technicalities. If this gentleman will get the daily reports before we cross examine him, from which this is made up, we have no objection, but this is only in lumps, and we have no means of cross examining the witness. If you use 100 tons one day and one ton the next day, the average does not mean anything.

MR. KREMER: Mr. Engleman will furnish those.

MR. GARRISON: I have no objection to its being admitted if they will follow it up with papers that will give that detail.

THE COURT: Do you want to have the witness testify now.

MR. GARRISON: I would prefer to have him testify when he gets his data so we can cross examine him.

THE COURT: I think you had better get it first.

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MR. GARRISON: I shall object in any event to the note on this exhibit.

MR. KREMER: That note says that the circulating load would increase the amount to over twenty ponnds to the ton. I think that should be eliminated. I will mark it out with a pencil.

MR. GARRISON: Mr. Williams is willing to have him go on.

MR. KREMER: We will eliminate the statement on this exhibit that is objected to.

MR. GARRISON: It is understood then, if this examination proceeds that we will not be required to cross examine until the other papers arrive.

THE COURT: That is, this data that has to be sent for—what is that?

MR. SCOTT: The daily details, I understand, Judge Garrison wants, for the years 1914, 1915 and 1916.

Q. 36. BY MR. SCOTT: Is that in tabulated form —those details?

A. It is not. We would have to bring all our records from the office up here, and it is a very difficult thing to do for three years back.

Q. 37. They are not compelled in form to bring them up?

A. No, they are not.

Q. 38. They are simply the memorandum books and the report books of all kinds?

A. Yes, and daily assay sheets and oil sheets. Each day has a separate oil sheet and a separate assay sheet,

and they would have to be collected for three years previous and brought up separately—that is, each one separately from the other.

MR. SCOTT: Until we find out whether it is practicable to get all these records here, I don't know that there is any object in examining Mr. Engleman. The other witnesses had their records in such form that they could be transported readily, but it seems that these records are not compiled.

MR. KREMER: We might simplify it by offering him as only to the 1917 report, and if we see fit to recall him as to the other years, we can do that after the gets his data.

MR. SCOTT: Well, I will confine the examination to the year 1917, and we will have this part of the compilation in such shape that it can be offered. We will have that done after the adjournment.

MR. SCOTT: Q. Have you directed the flotation operations on a practical scale with upwards of twenty pounds of oil per ton of ore?

A. Yes, sir.

Q. 39. During what period?

A. During the months of January, February and March, 1917.

MR. SCOTT: It is understood that we withdraw this exhibit now. It has not been admitted and therefore I prefer to withdraw it altogether.

MR. GARRISON: It has been admitted.

MR. SCOTT: No, it was not admitted.

Edward W. Engleman.

Q. 40. How great a tonnage have you treated in the flotation process with upwards of twenty pounds of oil to the ton?

A. We treated for the month of March 11,063 tons, using 21.19 pounds of oil to the ton.

Q. 41. And in other months how much did you treat?

A. In January we treated 9,300 tons with 20.02 pounds; in February we treated 8,550 tons with 18.77 pounds. The total for the quarter was 28,913 tons, and the average oil added per ton was 20.10. Now, in the month of January was that oil added, inclusive of the circulating oil or not?

A. The oil added in the month of January was new oil.

Q. 42. That is all that is taken account of in the figures that you gave, 20.02 pounds per ton?

A. Yes, sir.

Q. 43. You simply calculated the circulating oil altogether?

A. Yes.

Q. 44. And was there circulation during the month of January?

A. Yes.

Q. 45. You might briefly describe the flotation plant, and I think it would be well to make a sketch of it so that we may understand the procedure?

A. I have a small sketch here.

Q. 46. It would be a little better if we kept these of uniform size. You may prepare a sketch.

A. (Witness draws).

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MR. GARRISON: He has a sketch prepared.

MR. SCOTT: If you have one, you may use it. I did not understand that.

A. I have one. Our feed for this plant comes from the retreating plant classifier from the mill, which is what we call our low grade vanner concentrate, and the feed comes to this sump, and we add the oil at that sump, and a centrifugal pump pumps it up into the back, or into a small box feeding two emusifiers in series. The discharge from those two emulsifiers goes to five Janney mechanical flotation cells in multiple; each cell is fed separately from the other; we make a finished concentrate from each cell. The tailing from each cell goes to a launder and is combined as one product and from these five Janney mechanical flotation machines in series—these five are in series—the concentrate product from the five in series we call middling or circulating load, and that goes back to the sump where it joins the original feed, and then back to the emulsifier, and back through the first five machines in multiple. The tailing from the last series cell goes to waste.

MR. SCOTT: I will offer this sketch in evidence.

Sketch admitted in evidence without objection and marked DEFENDANT'S EXHIBIT 45.

Q. 47. MR. SCOTT: About how fine is this material that is treated in your flotation plant?

A. The screen analysis of the headings to the plant are 2.84 on a forty-eight mesh; 3.28 on a 65 mesh;

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9.91 on a 100 mesh; 12.93 on a 150 mesh; 12.50 on a 200 mesh; 12.93 on a 280 mesh; 45.61 through a 280 mesh.

Q. 48. Is that the only flotation system you have, the one you have represented in this sketch, exhibit 45?

A. Treating this product, yes, sir.

Q. 49. Have you a flotation plant for treating another kind of product?

A. Yes, sir.

Q. 50. What is that other product?

A. We have a flotation plant where we treat our slime vanner tailings.

Q. 51. Is that a still finer material than this that you have given the analysis of?

A. Very much finer, yes, sir.

Q. 52. Without giving the whole analysis, can you give in a general way how fine that material is?

A. Yes, sir; 2.22 per cent on a 65 mesh, and 69.05 through a 280 mesh.

THE COURT: Q. What is that, 280 ~~feet~~ holes to the square inch?

A. Yes, sir, 280 ~~feet~~ holes to the inch.

MR. SCOTT: I think it is 280 to the lineal inch.

Q. 53. Will you state, Mr. Engleman, the manner in which you estimate the circulating oil in these operations that have been conducted since January 1st with a comparatively large amount of oil?

A. Well, during the month of January we did not determine the circulating oil. It was during the months of February and March.

Q. 54. February, yes, I looked at this table wrong.

A. We employed an expert oil chemist to spend two months or two months and a half with us and he determined the percentage of oil in our circulating load, and his reports were submitted to me.

Q. 55. What can you say as to the relation of the results obtained since January 1 with substantially 20 pounds of oil per ton, and the results obtained prior to January 1, with the smaller amount of oil then used?

MR. GARRISON: We object, if the court pleases, if they are not going to give us the benefit of an examination as to the sources of his information.

MR. SCOTT: We are proposing to examine the witness as to his knowledge. We have offered this table in evidence and it has been objected to, but the witness knows the figures prior to January first and I am asking him to testify about them.

THE COURT: If he knows. The objection will be completed if you had not completed it, if you desire to urge it.

MR. GARRISON: My objection is this: He is now going to ask him with respect to results prior to 1917 and he has told us that he hasn't here anything from which he can testify as to the results prior to that year; but what he does have, is not the source of his original memory; it is all based upon data and that data he does not have here today. It is quite obvious that any answer that he gives us now will not be based upon any data which is probative. As I said a moment ago, I have not been technical; I have not insisted upon

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these gentlemen bringing their original records here; we have trusted to the character of their witnesses not to impose records upon us—or character of records—that were false.

THE COURT: The only question is whether he has information aside from the documents or having refreshed it originally from the documents.

MR. GARRISON: It may be that our objection would be captious if we did not refer to the answer in reference to this document to tell us results; but surely our objection is well founded when he has no independent knowledge. The only knowledge he has is what he obtained from some foreman.

THE COURT: I understand they were asking him if he knew of his own knowledge.

MR. GARRISON: No, he distintcly told us that he knows nothing whatever of his own knowledge. He only knows what was reported to him by these foremen and other men in the mill. He does not pretend to say that he stood and saw the operation from beginning to end. The objection is not captious. It is meritorious.

THE COURT: Well, if this witness knows anything of his own knowledge, not what someone reported to him or someone told him, he can testify; but otherwise, in the face of the objection the court will be obliged to sustain it.

(Question read as follows: "Q. What can you say as to the relation of the results obtained since January 1, with substantially 20 pounds of oil per ton, and the results obtained prior to January 1, with the smaller amount of oil then used.")

THE COURT: You are asking for results apparently made up from reports and records made and kept by others. I dont' think it is competent. I can not understand on what theory it would be competent.

MR. SCOTT: The witness in all probability has had access to these records here.

THE COURT: Yes, he has read the records.

MR. SCOTT: He has refreshed his recollection and he undoubtedly possesses that recollection still, and having that knowledge now, whether by prior memory or by having refreshed his recollection from original data, it seems to me he is entitled to testify to it.

THE COURT: They have waived the fact that a large part of it is hearsay, but they insist, if it goes in, they must have the records themselves. I think if they are going to waive that part of it, it is waived on a condition, if they are going to waive the strict letter of the law. No, the objection will be sustained.

MR. KREMER: We will qualify this; we will bring in these records and defer the examination upon them until they are here.

Whereupon an adjournment was taken until Monday, April 23rd, at 10:00 o'clock a. m.

Monday, April 23d, 1917.

THE COURT: Gentlemen, are you ready to proceed with the case on trial?

MR. WILLIAMS: I hand your honor a slip from the Patent Office, which the Patent Office attaches to every copy of the patent, which is a copy of the disclaimer.

MR. KREMER: That is not offered in evidence, is it?

MR. WILLIAMS: It is a copy—it has been sent to us by the Patent Office with instructions to annex it to the patent.

MR. KREMER: Are you offering it in evidence?

MR. WILLIAMS: Yes, we offer it in evidence.

MR. KREMER: To that we object for the reason that the disclaimer is no disclaimer in point of law, for the reason that said disclaimer, instead of relinquishing, extends the scope of the patent. For the further reason that the Supreme Court of the United States having declared claims 9, 10 and 11 of the patent invalid, a disclaimer can not be made by the patentee conditionally, but the claims having been declared invalid, they must be disclaimed in toto. For the further reason that upon the face of the record the plaintiffs and those owning the patent have been guilty of unreasonable neglect and delay in filing the alleged disclaimer. For the further reason that the plaintiffs and complainants and those owning the patent have failed to comply with the sections of the Revised Statutes of the United

States providing when and where and in what manner a disclaimer must be filed. For the further reason that the document here presented is not of a character purporting authority by certification or otherwise, such as to entitle it to admission in evidence in a case of this sort.

MR. WILLIAMS: I further offer in evidence a letter from the Patent Office, addressed to me, signed by the chief clerk of the Patent Office, with whose signature I am very familiar, although I am not testifying, but I presume Mr. Scott will acknowledge that—as follows: "Herewith please find printed copy of subject matter of disclaimer filed by you in Letters Patent No. 835,120, granted November 6th, 1906, to be attached to the original Letters Patent."

MR. KREMER: That is objected to as incompetent, irrelevant and immaterial, correspondence between counsel and the Patent Office.

MR. WILLIAMS: I will put it in the position occupied by it in every patent sent out by the Patent Office.

THE COURT: I think it is a mere matter of official detail, the disclaimer itself having been filed, because that was all that was required to give it whatever effect it is entitled to. The objections will be overruled.

MR. KREMER: Both objections?

THE COURT: Yes, both objections.

MR. KREMER: We desire to note an exception to both rulings of the court.

THE COURT: Exception may be noted.

MR. WILLIAMS: I ask leave to withdraw the original letter in view of the fact that the subject matter has been read upon the record.

THE COURT: Very well. Are you ready to proceed, Mr. Scott?

MR. SCOTT: I have made some progress, and I think we will now be able to get through about the end of next week, which will finish everything but the plaintiff's closing, and that will enable us to finish in about three weeks. I think it will be best to withdraw the witness who was on the stand Friday until all the objections can be remedied, and we can examine him in full.

THE COURT: Very well.

MR. SCOTT: For that reason I would like to call Mr. Dosenbach to the stand this morning.

THE COURT: Very well. Call your witness.

BEN H. DOSENBACH, a witness for defendant, after being duly sworn, testified as follows:

DIRECT EXAMINATION.

BY MR. SCOTT:

Q. 1. State your full name.

A. Ben H. Dosenbach.

Q. 2. What is your occupation?

A. My occupation is that of metallurgist and engineer.

Ben H. Dosenbach.

Q. 3. What has been your training and experience in that line?

A. For approximately the past four years I have been engaged in metallurgical problems and the operation of flotation plants and have been particularly engaged during that time in the flotation of ores. Previous to that time I was engaged in milling—in the general practice of milling through the various departments of the Utah Copper Company and the Ray Consolidated Copper Company at Hayden, Arizona.

Q. 4. Where did you receive your education in the line of metallurgy?

A. I received my education at the Missouri School of Mines at Rolla, Missouri, and also at the University of California, at Berkeley, California, having received a degree in mining engineering, and having specialized in metallurgy.

Q. 5. When did you first become occupied in investigating or practicing the flotation process?

A. It was in the year 1913, in April and May.

Q. 6. And for what employer, or for your own interest, was it?

A. I was employed by the Butte Superior Copper Company, now the Butte Superior Mining Company.

Q. 7. Did you have any experience with flotation before your employment with the Butte & Superior Company?

A. I did not.

Q. 8. Did you make any investigation along the line of flotation before your employment by the Butte & Superior Copper Company?

Ben H. Dosenbach.

A. I did not.

Q. 9. And what was your first work in connection with flotation?

A. My first work at that time consisted in observing the action of various oils and reagents that had been used in flotation, in the laboratory and also in an operating plant.

Q. 10. And what laboratory and operating plant was that?

A. The laboratory of the Butte Superior Copper Company.

Q. 11. And what ores?

A. The ores of the Butte Superior Copper Company.

Q. 12. And what apparatus did you use at that time?

A. The apparatus that was in use at that time was what was known as the slide machine.

Q. 13. Have you used other experimental apparatus since?

A. I have used various forms of apparatus since that time.

Q. 14. What was the nature of your employment, that is, your actual position or duties, when you were first employed by the Butte & Superior Company?

A. I was employed as metallurgist.

Q. 15. And you have held that position continuously up to the present time?

A. I have.

Ben H. Dosenbach.

Q. 16. And in that position what particular duties are you called on to perform?

A. Well, my duties consist of looking after any metallurgical problem that comes up, any new developments that arise in the metallurgical connection with the operation of the concentrate end of the mill and also the flotation plant, particularly the flotation section of the mill at the Butte Superior plant.

Q. 17. Did the Butte & Superior Company have a flotation plant in operation at the time you entered their employ?

A. They did.

Q. 18. Will you please give that date, just when it was you entered their employ?

A. To the best of my recollection it was in April or May, and I am fairly positive it was in April.

Q. 19. 1913?

A. 1913. I can look up the records and find the exact date, but I think it was in April, 1913.

Q. 20. About the time the Hyde case was argued in this court, was it not?

A. It was at the time the Hyde case was argued in this court because I was a spectator.

Q. 21. Well, describe generally the form of apparatus and the manner of its operation that was in place at the Butte & Superior mill when you came here, flotation apparatus?

A. In the mill?

Q. 22. Well, wherever it was?

A. At the time I came here and went to work for

Ben H. Dosenbach.

the Butte & Superior Copper Company, there was a flotation plant consisting of two roughers. The second day that I was here the plant was dismantled, and as far as I am concerned I can only speak of the flotation plant as it existed after starting up, having been shut down for a period of six days for remodeling.

Q. 23. You cannot, from your own knowledge, describe the plant as it existed before it was dismantled?

A. I cannot, in all details, no.

Q. 24. Well, if you have any personal knowledge about it you may describe it as far as that extends. How many cells were there, if you know, and matters of that sort?

A. There were, if I remember rightly, upon my first day at the Butte & Superior plant two roughers consisting of four spitzkastens and nine or eleven agitating cells to each rougher, and there was a cleaner in operation.

Q. 25. There was a cleaner?

A. Yes. That is as far as I can go as to the plant before it was remodeled. After the plant had been remodeled I was engaged—and during the remodeling of it I was engaged by the Butte Superior Copper Company so I can testify to that part of it.

Q. 26. And what was the nature of the remodeled plant?

A. The nature of the remodeling was to change the driving mechanism for one thing, to a gear drive; also to increase the agitation of the impellers; increase the speed of the impellers so as to cause a

Ben H. Dosenbach.

greater agitation; also to add additional agitating cells, and rearrangement of the flow sheet, where by a flotation plant was formed constituting of two roughers, having eleven agitating cells each, and four Spitzkastens each.

Q. 27. The extra agitating cells, I take it, received the pulp and agitated it before that went to the cells having the Spitzkasten?

A. Exactly so. There was also a cleaner which consisted of four agitating cells and four Spitzkasten, such cleaner making a final concentrate.

Q. 28. Was this plant, after being so remodeled, the final plant that remained in operation for a considerable length of time?

A. It did for a short length of time, possibly two or three months, when other changes were made and have continually been made up to the present time.

Q. 29. Can you remember the reason for the change being made in this remodeled plant?

A. The changes were principally to increase the recovery and produce a higher grade of concentrate.

Q. 30. Can you state from memory or by refreshing your memory how efficient the operation was when this remodeled plant started to work?

A. I think it would be advisable to look at some notes in order to give the exact figures, because I can't remember that far back as to such things.

Q. 31. If you have these notes in tabulated form you might produce them so that we can have them before us. Or, if you tabulated part of the result?

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A. I have tabulated the results at that time, and for a time later.

MR. GARRISON: Did I understand there was an unanswered question.

THE COURT: I think he has answered.

Q. 32. MR. SCOTT: Have you copies of this tabulation ready or aren't they ready yet?

A. I have them ready.

Q. 33. Are these the copies you refer to?

A. I don't see the copies that you refer to, Mr. Scott, in this list.

Q. 34. Well, have you any tabulation covering the period since you were in the employ of the company?

A. I have.

Q. 35. But there is no copy of it then?

A. There is a notation there which I don't understand.

Q. 36. If you have your copy of that tabulation, Mr. Dosenbach, that you can refresh your memory from, I would like you to state the nature of the results when this remodeled machine was first started up.

MR. GARRISON: I object, if your honor please. There is nothing in the testimony of this witness which justifies him in testifying from personal knowledge to the results of the operations of the machinery of the Butte & Superior plant from some indefinite date in April, 1913, for however long a period the question is assumed to cover. We have sufficient knowledge from the previous evidence on this subject that a gentleman occupying the position of metallurgist and engineer

does not have personal knowledge of these matters; he has such knowledge as is furnished to him by his assistants or underlings, who are the ones who actually do the probative thing. It may be probative in this case as to how much oil was used at a particular time; it may be the determining factor in the entire case, and it does not require elaborate discussion that that factor should not be put in evidence by one who has and can have no knowledge about the matter, by the nature of the case, excepting such as is conveyed from other and original sources of information. If that is not clear already with respect to this particular witness, I crave the right to cross examine before he be permitted to proceed with his original testimony.

MR. SCOTT: Mr. Garrison may cross examine if he wishes. I do not know what he is going to cross examine about. I put the question as to the details of this operation. In regard to the objection I might say that Mr. Dosenbach was in charge of these operations, and that he will testify from the official and original records of the company, and the only reason that I at all hesitate in attempting to satisfy counsel's demands in advance is the great amount of time that will be consumed. We have all these people accessible, the samplers, the assayers, the chemists, and the men who turned the oil on, and we can probably have several hundred employes here who performed each of these individual operations, if necessary. But the witnesses will testify as to operations under his immediate charge, refreshing his memory as to detail from the

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official records kept under his charge, and as far as he uses tabulations he will, upon request, furnish the figures and verify them from the original records, which are too voluminous to bring into the court room.

THE COURT: You may cross examine if you wish. Do you wish to proceed?

MR. GARRISON: Yes, sir.

THE COURT: You may do so and see how his knowledge is derived.

CROSS EXAMINATION

BY MR. GARRISON:

X-Q. 37. When you are asked to give the results of the operations of flotation plants with a view of stating whether they were good or bad or indifferent, upon what factors do you base your judgment?

A. I was asked to give the results of a flotation plant.

(Last question read)

MR. KREMER: We object to this for the reason that at this time it is improper cross examination. If the witness is being interrogated to ascertain whether he is competent to testify to the tables, the question is improper.

MR. GARRISON: I have not the benefit of having the table before me.

THE COURT: If you don't qualify your witness by your own examination or by this cross examination, the objection will have to be sustained. Your objection is overruled.

MR. KREMER: We are ready to bring all these witnesses here if counsel desires them. There are four or five hundred of them up there ready to come down, but it seems to me as a matter of law that if a man testifies to a condition which exists in an operation over which he has supervision, that that meets the requirement of law as to what was done in the operation. It is not necessary to produce every man that turned on a tap.

THE COURT: Your objection will be overruled, Mr. Kremer. Counsel may proceed with the cross examination and we will rule later on the other objection.

X-Q. 38. (Last question read again).

A. I base my judgment as regards the Butte & Superior flotation plant upon my actual knowledge of conditions which existed in the plant at that time, as my presence was there each day, and I was in direct touch with the operation of the plant. I was in charge of the plant; the men were working the plant under my direction, and I knew what the conditions were throughout the plant at that time.

X-Q. 39. Now please answer the question; I want to know on what factor you base your judgment.

THE COURT: Well, I think he has answered that.

MR. GARRISON: He is stating now, if I may interrupt your honor, the reasons which are going to induce him, as I understand it, to express a judgment. I did not ask him that; I ask you what factor,

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whether the grade of the concentrate, or the amount of the recovery—

THE COURT: You had better make that a little clearer.

MR. GARRISON: I thought the witness understood that, as a professional man.

X-Q. 40. Using the word "factor" to cover such things as grade and recovery and operations of the classifying machines, and various other parts of the operative machinery, upon which, or what part of those do you base a judgment as to the successful or unsuccessful operation of the plant that you are testifying to.

A. On the recovery; on the grade of concentrates produced; the successful operation of the plant and of the various machines that constitute that plant and all other factors which come into consideration in the operating of a plant.

X-Q. 41. The things which induce recovery in this flotation process are, broadly speaking, oils and acids. aren't they?

A. Yes.

X-Q. 42. And you, therefore, as another factor, have to consider the oils and acids used, do you not?

A. I do, and I have.

X-Q. 43. Do you personally measure the oil which from time to time is put upon the material?

A. I have.

X-Q. 44. (Last question read.)

A. I do, and I have.

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X-Q. 45. It is your duty every day, is it, to stand at the oiling machine and regulate it so that it puts the proper amount of oil on the material from hour to hour?

A. It is not, but it is my duty to see that the men who are working for me do that, and I check them up.

X-Q. 46. In what way do they inform you that they have done what you told them to do?

A. They submit a report each day, of the amount.

X-Q. 47. In writing?

A. In writing.

X-Q. 48. Are these oiling machines automatic or do they require the manipulation of human beings?

A. They require the manipulation of human beings, as almost everything does.

MR. GARRISON: The latter may be stricken out, because some of them are automatic.

X-Q. 49. Next in regard to the quality and character of the concentrates, how is that determined?

A. That is determined by analysis after a sample has been taken.

X-Q. 50. And who takes that sample? I don't mean the name of the man, but who, in the course of the business, takes the sample?

A. The sampler.

X-Q. 51. Is there more than one of him?

A. There is more than one.

X-Q. 52. Is that submitted to you?

A. That is submitted to the sampling department.

X-Q. 53. Is that submitted to you?

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A. It is submitted to me.

X-Q. 54. It comes to you first?

A. It does not come to me first, but it comes as a result.

X-Q. 55. Then to whom is it first submitted?

A. It is submitted to me as being one of the—

X-Q. 56. (Last question read.)

X-Q. 57. (Continued) You said it was not submitted to you first; now, to whom is it first submitted?

A. Well, I may have misunderstood the other question; I would like to have that re-read; I may change my other answer.

X-Q. 58. Certainly. I have not the slightest wish to confuse you. I want to know this: When the sample is taken by the sampler, what does he do with it; not what somebody else does, but what does he do?

A. He is taking the sample.

X-Q. 59. Then what does he do after that?

A. He submits it to the sampling department.

X-Q. 60. What do they do?

A. They submit it to the assaying department.

X-Q. 61. What do they do?

A. They analyze it.

X-Q. 62. What do they do with it?

A. They make a report of it.

X-Q. 63. To whom?

A. I get the report of that.

X-Q. 64. Does that also determine, not only the recovery, but also the grade?

A. It does.

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X-Q. 65. Who regulates the feed of the material?

A. The operators in charge of the flotation plant.

X-Q. 66. Have they any other title than simply operators?

A. Foremen; there are three of them.

X-Q. 67. And these foremen do they make reports of the rate, and the amount of feed, etc.?

A. They do.

X-Q. 68. What about the quality of the ore; who determines that, the amount of mineral in the ore?

A. That is also determined by the sampling and assay department.

X-Q. 69. Are there separate samplers who take that and take it to the assay department?

A. The same samplers take the original ore as take the concentrates and tailings.

X-Q. 70. And that all comes back to you in the form of written reports from somebody, does it?

A. It does.

X-Q. 71. And from all these original sources you make up these tables that you have been asked about, is that correct?

A. That is correct.

MR. ~~GARRISON~~ Kremer: I renew my objection, if your honor please.

THE COURT: What principle of the local law of evidence will you appeal to, just in general?

MR. KREMER: Only the general principle that a superintendent or manager of a business who has the personal conduct of the business and has at his disposal

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personally that which indicates the conduct of the business from day to day and upon which the business relies in conducting its ordinary affairs, he exercises a general supervision, he can testify to that which is carried on under his direct supervision, even though it is made from a number of different statements from different sources. It is the same principle of law that will permit a bookkeeper in a department store to testify that Mrs. Jones bought a paper of pins, a spool of thread and a yard of silk upon a certain day. They are entries made in the ordinary course of business. It would be a useless thing and an unnecessary thing to say that we had to call the girl who sold the spool of thread and so on—without prolonging the illustration. I am perfectly serious and I don't want to be facetious in the matter.

THE COURT: The Supreme Court of this state has ruled that the books which you speak of are only memoranda. It would not do for the bookeeper to come in and say that Mrs. Jones bought a yard of silk. That wouldn't prove it, necessarily.

MR. KREMER: Your honor is right in that assumption. I must show that these entries were made in the ordinary course of business. The mere fact that the books show a certain thing is not sufficient, and this is the test. The thing that makes this competent is to show that they were kept in the ordinary course of business. That is a pre-requisite. The mere presentation of the books is not sufficient. But, if the books are shown to be kept in the ordinary course of business there is a presumption that in the keeping of these accounts and books

and records of the business, in its course of conduct, are correct, and relying upon that, in giving the direction to your business, there is a presumption based upon that reason that fallacious conditions would not exist because the whole business would be destroyed. That is the evidentiary principle, and that is a prerequisite, and so that is the ground I have earnestly contended that from the very beginning if it is shown that these records are made up in the ordinary course of business and are the records of a going operating concern, where one has had a superintending capacity over them and can identify them as the result of the ordinary conditions of the operation, that that is sufficient. Now, the reason for that, if your honor please, I think becomes apparent. Take the question which your honor now has under consideration. This is not something that is not available. This is something that—if the rule of law is not as I maintain, that it is and I earnestly contend that it is so, but if it were otherwise, we can prove these things; but the rule of law exists solely for the purpose of obviating the necessity of doing such a useless thing as here one would be called to do, to bring down at least, without any exaggeration, fifty or sixty men for the purpose of saying: Yes, that is so; I did it; it is correct. "Do all the duties that you perform in the course of your employment indicate the correctness of your actions?" "Is this true?" "Did you make a mistake?" "No." "I did not." "They are all correct."—Bring each one of them down and it is basically proven, what the law of evidence I think considers a useless thing, a useless

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showing. And for that reason this very same and logical rule is adopted. There is no position that counsel are placed in that would cause them to suffer the slightest embarrassment, because they can attack anyone of these various matters, even to the end of calling the men. I don't think there is any difference in the rule of law of the records of an operation conducted in the ordinary course, under the supervision and superintendence of one who says he knows it to be correct. Now, the test of the credibility of this would resolve itself solely into the impression that the witness created upon the court.

MR. GARRISON: Have you finished?

MR. KREMER: I have.

MR. GARRISON: As far as Mr. Kremer has gotten in his exposition of the law, he has stopped far short of what he has offered here, and I do not think it is worth while to discuss something that is not before us. He says that if they had regularly kept books which are not themselves the books of original entry, but are made up of other original sources of information, these books are admissible. I do not care to debate that with him, if that was what was offered. We have no such thing offered now. We have a table made up by this witness, something typewritten perhaps day before yesterday—it makes no difference when it was typewritten, or when it was composed. It does not purport to be a book of the company made up in the ordinary course of business part of their daily routine, with whatever effect, legally, that might have as evidence. And I most respectfully submit that no authority in any court of justice under

the common law can be found for giving probative force to a table made up by a witness from not even original sources of information of his own. That is a very doubtful question, if not determined entirely the other way, but certainly not a table made up from original sources of information of which he has no knowledge whatever. That could have no probative force. The very statement that it would take 500 men to justify this table shows the table itself cannot be evidenciary.

THE COURT: Suppose he has made it from daily reports in writing to him by numbers of subordinates? Can't he make a tabulation from those reports?

MR. GARRISON: After they are in evidence.

THE COURT: Bringing his records along, say, "Here are the reports; here are my papers."

MR. KREMER: We will produce all of them—I beg your pardon, I did not intend to interrupt you—if you desire all of these I will produce them; they are all available.

THE COURT: Just a minute. Let the counsel discuss this with the court for a minute or two.

MR. KREMER: I beg your honor's pardon.

THE COURT: I want to know what their position is. Now,—

MR. GARRISON: I have known the rule to be stretched to this extent, for the benefit of the court and solely for the benefit of the court, that where the original sources of information are numerous, such as these reports undoubtedly are, and where the only proof that may be offered, which is these reports has been offered and accepted, the court has then permitted someone

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like an auditor or a supervisor or a superintendent or a manager to tabulate and make a statement which is given him as illustrative of his evidence; but it has no probative force whatever, absolutely no probative force. It simply is illustrative, of his evidence, he having gone through the original sources of information for the benefit of the court and furnished the court with a convenient tabulation. Now, I have never known it to go any further than that.

THE COURT: As supplemental of this report, and you have them to verify.

MR. GARRISON: Precisely so. We have got the cart before the horse, as unfortunately we are so often faced with in this trial.

THE COURT: Let's proceed a little farther. The court will not attempt to limit you. You say you have these reports, but not here.

MR. KREMER: Certainly; we haven't them right here. They will be here as fast as a couple of wagons can bring them down.

THE COURT: My only question is on the attitude of counsel. You must remember we are trying this case according to the established rules of evidence, except as there may be some special rule established by Congress, and I do not know of any local rule or any decision of the Supreme Court that will allow you to introduce books and let a bookkeeper say—or introduce reports and let an auditor say or a bookkeeper "These are furnished to me every day and are represented to be correct." I don't know of it. I think it is rather the other way in this jurisdiction.

MR. KREMER: I agree with your honor. Naturally we will proceed to supply the original documents.

THE COURT: Since you can supply it and since you have insisted on it you better have these things here and then we will meet these objections when the time comes.

MR. KREMER: We will be very glad to bring up all of the books and reports and they can bring all the men if they want them.

THE COURT: The court is naturally anxious for anything to expedite things, and to expedite things, but it must see that this case is tried according to settled rules of evidence. They have the right to insist upon it, if that is the law. Now, if you have any authorities with you I would be glad to hear them.

MR. KREMER: As to my position, I think I can furnish you with a host of authorities.

THE COURT: We will give you an opportunity to be heard. This objection will be—

MR. SCOTT: May I ask the witness how long it will take to get these original reports? They include all the assay sheets I suppose and many other memorandum and reports?

MR. DOSENBACH: Well, I should say it will take a day, all of today.

MR. SCOTT: Well, then, we will have to withdraw this witness and continue his examination after we are able to obtain these original records.

WITNESS TEMPORARILY EXCUSED

THE COURT: I would be glad to see from both sides, if these questions and these objections to this character of proof are to be offered and this variety of objection interposed, I would like to see the local law, the decisions in point, and others also if there are any that we ought to consider and be controlled by here.

MR. KREMER: A very recent decision and I think your honor probably has it in mind, by our Supreme Court in connection with the record of account, which I think is what your honor had in mind when you said that the book itself would not be evidence—a case decided about 18 months ago—but this was not supplemented by the testimony of the correctness by one who had charge of the records. I think that is the distinction there, otherwise I think that we would quite agree that that was the rule.

THE COURT: You may look up the question and I will hear you later on both sides. In further reference to the point that has come up. Unless the sources from which he made his compilation would themselves be admissible, of course the compilation would not be admissible and would these reports that he received daily from his subordinates of themselves be admissible without verification by the subordinates who made them? That is one of the principles involved in this question.

MR. KREMER: I would say this: That if the report was the subject of something that was conducted under the supervision of the manager or superintendent, and were submitted to him in the ordinary course

of business, they become a course of business. Now, for instance, just use this test, if your honor pleases: Suppose this was an action for accounting. Could there be any question but what these reports would be absolutely conclusive against us, if admitted.

THE COURT: Of course evidence that might be conclusive against you may be no evidence in your favor.

MR. KREMER: Only for this reason and that is because they are interpreted to be self-serving declarations. But the purpose for self-serving declarations did not exist at the time of the making of the reports, so that test is removed.

THE COURT: Well, but this litigation has been pending a long time. Most of these things you are asking about I suppose was previous to the litigation.

MR. KREMER: But there was a time previous to this litigation when all—

THE COURT: All right, we will hear the law on that, but I simply want to hear you.

MR. SCOTT: We will have Dr. Sadtler take the stand for a part of his testimony.

THE COURT: Very well.

DR. SADTLER, called as a witness in behalf of the defendant, being first duly sworn, testified as follows:

MR. WILLIAMS: In regard to this question of the character of proof for admitting further operations at the Butte & Superior mine. The plaintiff is de-

sirous of facilitating the presentation of the case, but plaintiff is suspicious of reports that are made up for the purpose of this trial. Now, I take it, that in the records of the Butte & Superior Company in the ordinary course of their business, that from time to time a regular tabulation—in the ordinary course of their business they from time to time prepare a regular tabulation of their operations. Possibly this witness has tabulations made covering periods of time. The point that we are insisting upon is that we should have these things that were not prepared for this trial, but were prepared in the ordinary course of business of the company, and if there is any way of presenting it upon such a basis as that we will not insist upon all the original written sheets or anything of that sort. We do not want to stand for the strict measure, but we do want these records and reports which were prepared in the ordinary course of business, to compare.

THE COURT: There is a way you can get them possibly if you confer together you can arrange the point.

MR. KREMER: My only purpose in making that —anything you want we will furnish you along that line, but it does seem to me that to do that useless and idle thing, which we will now proceed to do, to load up a couple of trucks and bring them into this room—we will give you whatever you want. If you wish Mr. Dosenbach to proceed, Mr. Dosenbach will testify from his notes and from his compilation as to the conditions. Then if you have misgivings as to certain portions of

that testimony you would in turn then demand and say, "Will you furnish us with the copies of those days or those months operations." Very gladly we would do it; very gladly do it. But otherwise we will comply with the decision and the ruling, of course. Of course we are going to get this testimony in and if that is satisfactory to you we will do it, and if we are not able to furnish it or do not furnish it upon demand we, before the motion is made, consent that that portion of the testimony may be stricken out.

MR. WILLIAMS: I do not know how the Butte & Superior Company keeps its records. You and the witness do.

MR. KREMER: I suppose the witness does.

MR. WILLIAMS: Suppose for example that the witness were to say that on a certain day the operations were as follows:—he would produce a report of that day which he made at that time and his records, would he?

MR. KREMER: Yes.

MR. WILLIAMS: And then we could have that put in evidence.

MR. KREMER: Yes, I think that is correct, isn't it, my statement—I answered "Yes" because that was my idea.

You would testify upon a certain date the operation was so and so, using a more specific illustration, you used a certain amount of oil. That is made from a compilation of the records submitted to you in the operations over which you had supervision.

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MR. DOSENBACH: Yes.

MR. WILLIAMS: And you can produce the record for that?

MR. DOSENBACH: I can produce the oil record for that day or any other record of that day.

MR. WILLIAMS: And you have memoranda of this which you made at that time, is that right?

MR. DOSENBACH: Yes.

MR. WILLIAMS: We will waive the strict measure of proof if we may proceed in that manner.

MR. KREMER: We will be very glad to comply with any such.

THE COURT: Will this witness testify?

MR. KREMER: He will be withdrawn and Mr. Dosenbach will proceed in the regular way.

THE COURT: I understand he hasn't the records with him at this time so ~~as not~~ that he will have ~~him~~ to take the stand and leave it again.

MR. KREMER: We have the stipulation and Mr. Williams will ask us to furnish him certain records which we will furnish without bringing the whole office down.

THE COURT: If you think you can negotiate to restrict the record, it will be to the advantage of both, and of course to the court; but the court when an objection is made, will rule on it. Is this witness, Mr. Dosenbach, to testify now, and produce these records later if you call for them?

MR. KREMER: And you can recall him for cross-examination upon them.

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THE COURT: He hasn't them in court then this morning.

Q. 72. MR. WILLIAMS: Mr. Dosenbach, what records have you with you today? Suppose I were to ask you what the operations were on a certain day, what have you to show those operations?

MR. DOSENBACH: I have the daily records for the—of all of 1917 with me today.

Q. 73. MR. WILLIAMS: And nothing more?

MR. DOSENBACH: And the daily records prior to that time I haven't with me.

MR. WILLIAMS: You better have these with you before you testify.

THE COURT: Very well, proceed with the witness.

MR. SCOTT: In order that there may be no misunderstanding, I would like to ask what these daily records that he refers to are so as to be sure that they will be such as will be acceptable. What are these daily records, Mr. Dosenbach, for 1917, that you refer to; something that you have compiled from original records or are they the original records?

MR. DOSENBACH: They are not the original records; the compilation of each day's original records.

MR. SCOTT: Supposing you let me see what they are and we will find out so that when we come to it again we will know. What was the nature of the original records? Is there any single original record containing all of the information for one day? Does it all show there for one day on that tabulation?

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MR. DOSENBACH: There is no single record.

MR. SCOTT: How many single records for each day would be necessary in order to put before the court the history of that day's operation?

MR. DOSENBACH: Well, I suppose from 6 to 18.

MR. SCOTT: And these records, what are they?

MR. DOSENBACH: The oil records.

MR. SCOTT: Made by the oil sampler or chemist?

MR. DOSENBACH: Oil foreman. The assay record.

MR. SCOTT: Giving the grade of concentrate, headings?

MR. DOSENBACH: Yes, headings and tailings. The tonnage record samples.

MR. SCOTT: Made by some one in charge of that?

MR. DOSENBACH: Yes. And the oil analysis record made by the oil chemist.

MR. SCOTT: All of these are separate reports, are they?

MR. DOSENBACH: They are.

MR. SCOTT: Are there still more of them?

MR. DOSENBACH: Well, then there is the individual shift report.

MR. SCOTT: What does that set forth?

MR. DOSENBACH: That sets forth the operations of the flotation plant, the amount of oil used, the amount of acid used, the amount of other reagents used, and other factors that are taken into consideration in directing the operations of the flotation plant.

MR. SCOTT: That about covers it?

MR. DOSENBACH: That will cover it pretty well.

MR. SCOTT: Now, in connection with any particular operation that is required you want those records that Mr. Dosenbach mentions, these original certificates, do you?

MR. WILLIAMS: We may.

MR. SCOTT: Well, do you want them all brought here or do you want to make us a list of your requirements during the examination so that they can be sorted out and brought here in a bunch?

MR. WILLIAMS: We would be willing to call for any particular requirement and give you an opportunity to bring it later.

MR. KREMER: Why can't we proceed then? We will accept that.

MR. WILLIAMS: As I understand it, there is practically nothing in the way of daily reports prior to 1917 that the witness has with him. Therefore he will be unable to give us any information.

MR. SCOTT: In 1917 he has his compilation. He hasn't these original papers that you have been speaking of.

MR. WILLIAMS: And prior to 1917 he hasn't anything except a general tabulated statement which we don't regard as evidentiary until something else is produced.

MR. SCOTT: Well, these tabulated statements prior to 1917 are of course the averages of daily operations, for any of which daily operations he can produce the original memoranda that you refer to.

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MR. WILLIAMS: I think that when the witness has brought with him a tabular statement of daily operations prepared not for this trial as I understand—

MR. SCOTT: There is no such thing, they are not prepared in that form for any other purpose.

MR. WILLIAMS: And for that total statement of daily operations then as I understand it, he has none for 1917. We will endeavor to make such a waiver of strict objection as will bring about the production speedily of the evidence that the defendant desires.

MR. SCOTT: Mr. Dosenbach, one more question, please. Will it be possible within the limits of time of this trial to prepare a daily statement for the years prior to 1917 corresponding to the daily statement I think you have for this year?

MR. DOSENBACH: It would take quite a long time. I don't know whether it would be possible to get it out or not.

MR. KREMER: The limit of the trial would be proof of this.

MR. GARRISON: I think we would make progress if we have a conference during recess and see what we can do about this thing. Is that satisfactory, gentlemen?

MR. KREMER: Yes.

MR. GARRISON: We will have a conference at recess and endeavor to shorten this thing as much as we can.

SAMUEL P. SADTLER, after being duly sworn as a witness for defendant, testified as follows:

DIRECT EXAMINATION.

BY MR. SCOTT:

Q. 1. Please state your name.

A. Samuel P. Sadtler.

Q. 2. Doctor, please state your occupation and qualifications to testify on subjects of the kind before the court.

A. I have been a professor of chemistry for many years, but am not now active in that line, but for the last thirty years I have been a consulting chemist in connection with many chemical manufacturing operations, and have particularly practiced as a chemical expert in chemical patent litigation during the last thirty years. Do you want my educational qualifications?

Q. 3. I think so, doctor.

A. I was graduated in 1870 as a bachelor of science from Harvard University. In 1871 I made my Doctor of Philosophy degree in the University of Goettingen, Germany. Since 1871, as I said, I have been teaching chemistry, and for thirty years past actively in the practice of applied industrial chemistry. I have made a particular study of industrial chemistry in most of its branches, and I published already in 1891 a Handbook of Industrial Chemistry for manufacturers as well as students, in which the chemistry of petroleum and of

oils, both fixed oils and fatty oils was thoroughly covered, both the chemical nature of these materials, as well as the manufacturing operations and a study of the products. I have also had special experience in connection with the nature of essential and fatty oils, because I have been since 1880 the chemical editor of the United States Dispensatory, which is a standard book covering a wide range of materials of this kind, particularly for reference in the medical and pharmaceutical profession. I have had a special acquaintance with petroleum matters, however, because, from 1875 on I have been collecting and classifying petroleum and petroleum products, first for the Geological Survey of Pennsylvania, and afterwards for the various parties who desired investigations of these materials, and in that connection I have visited the petroleum fields throughout the country. I have also had, in connection with my patent litigation work, the study of a great many products, both in oils of petroleum and fatty and essential oils.

Q. 4. Have you made any investigation of the processes referred to in United States Patent 835,120, the Patent here in suit?

A. I have personally carried out experiments in that line, and have witnessed a great many other experiments, beginning with the summer of 1914.

Q. 5. I notice that in the opening part of this patent reference is made to certain Cattermole patents, Nos. 777,273 and 777,274, and the text of the patent purports to draw a certain distinction between those Cat-

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termole patents and the process of Patent 835120. Can you state whether your investigations have confirmed the distinction there set forth or not?

A. That question is so comprehensive that I would have to analyze it in some detail.

Q. 6. You may take your time, doctor.

A. I would like, before attempting to make any attempt at sharp distinctions—I would like to classify in a general way the processes which involve the use of oil in oil concentration. The first use of oil in this connection of oil concentration would be for the purpose of agglomerating the sulphide and other mineral particles into masses from which the gangue can be separated by various washing out processes. Now, in this category will fall, of course, the Cattermole process of making granules and washing them out by up-cast. In this category would also fall the Haynes invention described in the Haynes patent, and the first process of Everson would also involve the agglomeration or bringing together of the sulphide particles with oil and the washing out process.

The second category is that of producing conditions which will permit a flotation of sulphide particles by attachment to gaseous bubbles in which case the amount of the oil and the character of the oil are varied quite considerably, and will vary, according to practical experience, with the individual ores to be treated. Under this category will fall the patent in suit, No. 835120, and a number of patents of the prior art, viz., Everson Second Process, for example; Froment; the foam effect

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method of the California Journal of Technology; and Kirby.

The third category includes those processes in which the particles are caused to float as a film on the water's surface, mainly by reason of the surface tension. A number of patents have been taken out in that line: MacQuisten, and some of the patents of Sulman & Picard.

The fourth and last category is where the sulphide particles are to be floated by the actual buoyancy of the oil, under which category we have the Elmore process, which was also discussed by the writers of the California Journal of Technology, articles, under the name of the "Lake Effect."

I have thus, in a general way attempted to classify the various processes, and with this classification in mind I am ready to take up Patent No. 835120 and discuss it, and incidentally in that connection the differences from Cattermole will be indicated.

In Patent 835120 we have first of all a statement of invention. Now, the statement of invention is one of the earliest parts of a patent, and that is found on page 1 of the patent, lines 9 to 15, and again, lines 28 to 35, we have the following:

"This invention relates to improvements in the concentration of ores, the object being to separate the metalliferous matter, graphite and the like, from gangue by means of oils, fatty acids, or other substances which have a preferential affinity for metalliferous matter over gangue." And again in line 28:

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"We have found that if the proportion of the oily substance be considerably reduced, say to a fraction of one per cent of the ore, granulation ceases to take place, and after vigorous agitation there is a tendency for a part of the oil-coated metalliferous matter to rise to the surface of the pulp in the form of a froth or scum."

That last portion, beginning "there is a tendency," is therefore the result of the invention. That is the result of the invention. "A tendency for part of the oil-coated metalliferous particles to rise to the surface and form a froth or scum."

Now we have, following that, a statement as to how this tendency is aided. In lines 35, and following on for some distance, I read:

"This tendency is dependent on a number of factors," and the factors mentioned here are three in number. "Thus the water in which the oiling is effected is preferably slightly acidified by adding, say, a fraction of one per cent of sulphuric acid or other mineral acid or acid salts, the effect of this acidity being to prevent gangue from being coated with oily substance, or, in other words, to render the selective action of the oil more marked; but it is to be understood that the object of using acid in the pulp according to this invention is not to bring about the generation of gas for the purpose of flotation thereby, and the proportion of acid used is insufficient to cause chemical action on the metalliferous minerals present."

That is the first factor which is to be considered in understanding this tendency, referred to before.

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The second factor is: "Again, we have discovered that the tendency for the oily substance to disseminate through the pulp and the rapidity with which the metalliferous matter becomes coated is increased if the pulp be warmed." That is the second factor.

Again: "The formation of froth is assisted by the fine pulverization of the ore, and we find that slime mineral most readily generates scum and rises to the surface, while larger particles have less tendency to be included in the froth." That is the third factor.

Those are the three factors which are mentioned.

Now, turning for a moment to lines 89 to 96 inclusive, we have a statement of the observation of the patentees: "When agitation is stopped, a large proportion of the mineral present rises to the surface in the form of a froth or scum." That is the observation. Now, we have following that a statement from that observation, an expression of a theory:

"Which has derived its power of flotation mainly from the inclusion of air bubbles introduced into the mass by agitation, such bubbles or air films adhering only to the mineral particles which are coated with oleic acid."

This is the only statement of the theory of air bubble flotation as produced by vigorous agitation, which is contained in the patent.

When operating the second alternative process which is referred to on page 2 of the patent, this theory does not apply. On page 2 of the patent, line 103, we have an alternative method given. This alternative method

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involves the recovery of the sunk oiled metalliferous matter which may be deposited in the second or third spitzkasten, and, is as follows:

"The products suspended in circuit liquor are removed from the spitzkasten and placed in a vessel in which they are submitted to an additional pressure of air or other gas of from, say, one to two atmospheres or over. On relief of such pressure the bubbles of air or other gas so generated throughout the mass at once sweep to the surface thereof all the metalliferous matter in the form of a froth which can be separated as before."

It is not dependent upon the entraining of the air by vigorous agitation, but is a secondary process for the recovery of additional metalliferous matter by the generation of bubbles following the introduction of air or gas under pressure in the liquid, which bubbles rise and carry, attached to them, a certain additional amount of mineral particles. None of the claims of the patent give us any theory of oil flotation, neither the theory mentioned on page 1 nor the method referred to on page 2. These claims, therefore, tell us nothing in regard to the air bubble production or the function which was ascribed to it in those lines on page 1. The claims are referred to a froth production as a result of agitation, and in those claims, which have been declared valid by the United States Supreme Court in the Hyde process, this froth production is specified to be in the presence of an amount of oil less than one per cent.

Now, going back to the theory of lines 92 to 96 on

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page 1—it is not new to this patent. It is found stated quite clearly in Patent No. 793808, page 1, lines 65 to 79, a prior patent issued to Sulman & Picard in July, 1905. I find it there stated:

"The oiled metalliferous particles resulting from either of the processes above described have the power of attaching to themselves with a greater comparative strength than the gangue particles, the films or bubbles and gas, which exist in the mass, and are thus raised to the surface of the liquor by gaseous flotation. They can then be removed by skimming or other suitable means. The gangue particles unwetted by oil or grease are not floated up with the oiled mineral particles, and thus in the main remain at the bottom of the vessel containing the mixture."

By the above matter this function of the gas bubbles is clearly stated. Also in Froment, the Italian patent dated 1902. In the third paragraph of this patent we find the following:

"If a gas of any kind is generated in this mass, the bubbles of this gas become covered with an envelope of sulphides, and thus rise readily to the surface of the liquid, where they form a kind of metallic magna."

I think all the essential features of the theory stated, therefore, on page 1 of Patent No. 835120, can be found in these two prior references which I have mentioned.

Various statements have been made by the witnesses and by counsel in different stages of the Hyde case to the effect that the patentees discovered a new agent in

the air bubbles which, in combination with oil in unheard of minute proportions, and in such proportions performing a new function, accomplish a new and revolutionary result; that under an intense agitation in the presence of a mere trace of oil, such that the metallic particles are coated with a thin, attenuated coat of oil, so thin as to be imperceptible to sight or touch, and so attenuated as to exhibit none of the known properties of oil—air bubbles would be produced and controlled and made persistent; that would firmly attach themselves to the metallic particles, and by their buoyancy float the heavy metallic particles upward to and through the surface of the pulp and form above, and resting upon the surface of the pulp, a floating layer usually several inches in thickness, of a mineralized froth, constituted of such air bubbles carrying the metallic particles. It was so stated at the time that these expressions were used in relation to the invention of the patent, 835120. I do not find this at all in lines 28 to 36, in which the patentees state their invention. They claim only a tendency for a part of the air coated metalliferous matter to rise to the surface of the pulp in the form of a froth or scum, and as before noted, this tendency, the patent says, is dependent upon a number of factors.

I will now take up these factors in detail and examine as to what rights these patentees have in the claiming of the use of these factors as original. The first mentioned factor was the presence of a small amount of acid. That, however, belongs to the prior

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art. Dr. Liebmann, one of the former experts in the Hyde case, (Hyde original record ~~case~~ page 495) says: "Carrie Everson discovered that preferential ability was rendered more effective and more pronounced if acid was present in the oiled pulp." Later ones of the prior art also use it and comment upon it. We find those references in Cattermole, and California Journal of Technology, and in Kirby.

The second factor is stated to be the use of heat. This also is not original. We find this also referred to already in the Fryer Hill publication on the working of the Everson patent. Dr. Liebmann says (Hyde original record page 544): "The Fryer Hill Publication of 18~~9~~89 is clearly a further development of the Everson patent. It adds to Everson the use of heat." Kirby also refers to the use of heat if desirable.

The third factor which is referred to in patent 835,-120 is fine pulverization. While this was not emphasized by most of the prior workers, indications to show that it was not a new feature are seen. The Italian patent of Froment refers to natural sulphides reduced to fine powder as the subject matter of his experiment. In the English patent of Froment, the patent solicitor, Lake, dropped the word "fine." In Kirby patent we have similar indication that fine pulverization was practiced. On page 3, lines 51 to 55, we have the words: "The water, even near the top, is not clear, but turbid or muddy, with slimes or fine particles of non-coated minerals, which had not settled rapidly enough to get out of the way." The practice and value of fine pulv-

erization is also mentioned in the earliest of the Cattermole patents, which was of course familiar to the patentees of No. 835120.

Q. 7. What was the number of that earlier patent?

A. I will give it to you. The Cattermole patent 763,259, line 90 on page 1 indicates this as follows: "The finer the ore the more compact and cohesive are the granules formed from it, other things being equal." I turn now to the nature of the product disclosed in patent 835,120. The product of the invention is stated in line 35 of page 1 to be a froth or scum." In giving their theory as to the froth production in lines 91 to 96 of page 1 the patentees say: "A froth or scum which has derived its power of flotation mainly from the inclusion of air bubbles introduced into the mass by agitation, such bubbles or air films adhering only to the fine particles which are coated with oleic acid." The claims of patent 835,120 all refer to the froth with no mention of its structure or component parts. The question now to be dis~~closed~~cussed is: Was this gaseous froth produced by agitation a new discovery? An examination of the prior art will show that it was not. It was produced in the practice of the second method of the Everson patent. The Everson patent, page 2, line 99, to 105, says: "In practice, the concentrate, after thorough agitation of the mass and detachment of the sand, will in this case be preferably removed by means of a constant overflow of water from a washing-out vessel, by which overflow the concentrate will be floated off." We have here, as first stated, the thorough agitation of

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the oil, principally to entrain air; second the detachment or settling of the sand; and third, the floating off of the concentrate as an aerated froth. In the Fryer-Hill publication of 1889 describing the carrying out of the Everson process we are told that the action of the revolving tube, the fans and injected acidulated steam causes the lighter portions of the mineral-charged oil to float. This was clearly a mineral-laden aerated froth. I have no paging or number of lines to indicate the exact position of that in the Fryer-Hill publication, but it can easily be found. In the Criley and Everson publication, still referring to the carrying out of the Everson process, we are told that as a result of the operation a thick scum of sulphurets rose to the surface and was skimmed off. As the patent in suit uses the words "froth" and "scum" as synonymous, there is no reason to doubt that this was aerated froth or thick scum of sulphurets full of air bubbles which as described left the hitnerto black ore as white as snow, in fact pure silica. We have next the Froment Italian and British patents. We are told by counsel for the Minerals Separation that following the issuing of the British patent, August 8th, 1903, Mr. Sulman saw a publication describing it, and learned thereby that Froment was an earlier inventor of the broad idea of floating oil-moistened metallic particles by air or other gases which had been invented by himself and Mr. Picard. This states the facts. The British patent ot Froment says: "If a gas of any kind is liberated in this mass the bubbles of the gas become covered with

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an envelope of sulphides and thus rise readily to the surface of the liquid, where they form a kind of metallic magma." It will be noted that it is the bubbles of the gas which rising form the magma. This magma of gas bubbles coated with oil, and covered with an envelope of sulphides is undoubtedly an aerated metal coated froth, which has often been described by plaintiff's counsel as a heavily, armor-coated froth, capable of having considerable superimposed weight upon it. But we are not obliged to trust to our own views on that subject. We have the testimony of Minerals Separation themselves as expressed in the language of patents applied for and issued to them at a considerably later date than the date of patent 835,120. The views held by Minerals Separation Limited as late as 1910 as to the character of the Froment process and as to its being a true gas bubble flotation are clearly shown in the language of two patents taken out by them in that year. First, British patent No. 10,929 of 1910, to Theodore Jesse Hoover and Minerals Separation Limited. In the complete specifications, page 2, lines 47, continuing to page 3, line 4, we find the following: "The object of this invention is to provide simple and effective means for the introduction of air or other gas in a state of extremely fine division into an ore pulp in such a way as to effect the gaseous flotation of certain particles. For example, the patent No. 12,778 of 1902 describes a process of ore concentration which consists in mixing the finely powdered ore with water, adding a suitable oil and then liberating a gas in the mixture so

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as to carry the oiled particles to the surface in the form of a froth, and the present invention is particularly applicable to a process of this general type." This patent No. 12,778 of 1902, is the British Froment patent. Again, in this same patent, No. 10,929 in 1910, on page 3, lines 30 to 34, the character of the Froment process is still more expressly stated in the following language: "A number of ways are known for treating an ore pulp to facilitate or to render possible the selective flotation of certain constituent particles in the form of a gaseous froth, see for example the processes described in patents Nos. 12,778-1902, 7,803-1905, 28,173-1908, and 2,359-1909. The present invention may be used in conjunction with any such process." It will be noted here that the Froment British patent is bracketed immediately with British patent 7,803 of 1905, the patent corresponding to that patent 835,120 as easily productive of a gaseous froth as its result. British patent No. 23,870 of 1910 to Minerals Separation Limited and Edward H. Nutter, in the complete specifications, page 5, lines 22 to 24, after referring to their invention as a flotation process obtaining froth or scums containing metallic components, says: "The processes employed to obtain these froths or scums may be any of the well known flotation processes as described for example in patents Nos. 12,778-02, 29,374-04, 7~~5~~,803-05, 26,852-08, 28,173-08, 2,359-09, etc." We note here again the bracketing of patent No. 12,778 of 1902 and 7,803 of 1905 as equally valid and available. These two patents, thus bracketed, were the Froment British pat-

ents and British patent corresponding to 835,120. They are declared as equally valid and available for raising froths and scums containing mineral oil. We also note the reference in this patent 23,870 of 1910, to both the patents 12,778 of 1902 and 7,803 of 1905 as well known flotation processes.

We have next, in the prior art, the publication known as the California Journal of Technology issued in November, 1903.

MR. WILLIAMS: If your honor pleases, that not being in evidence, and therefore your honor not having a copy of it, while I do not wish to interrupt the witness, I think defendant's counsel should at least supply your honor with a copy of it. Of course it was gone over thoroughly in the Miami case and your honor has perhaps seen it.

MR. SCOTT: We can furnish the copy.

MR. WILLIAMS: I suggest that you furnish a copy to the court.

MR. SCOTT: The original is on page 34 and continuing.

MR. WILLIAMS: Now, for instance, there is another patent the witness has just referred to, Hoover British patent, 1910—something, and your honor has never seen that. It is not in evidence, and if you will just hand that up when the witness refers to them, I think it would help the court.

THE COURT: You may proceed.

A. Well, next, the publication known as the California Journal of Technology issued in November, 1903.

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MR. KREMER: At this time we offer in evidence the California Journal of Technology, the articles found on pages 34 to 41, the number of November, 1903.

MR. WILLIAMS: The only objection that is made to this publication is on the ground of estoppel; this new defense can not be interposed. Although the document is not proved to be a publication, we are satisfied from investigations that we have made that it is, so we do not object to it on that ground.

Objection overruled. Plaintiff excepted.

California Journal of Technology of November, 1903, marked *Defendant's Exhibit No. 47 and admitted in evidence.*

Whereupon an adjournment was had until 2:00 p. m.

2:00 o'clock p. m.

BY MR. SCOTT:

Q. 8. Doctor, do you remember where you left off before the adjournment for lunch?

A. I had mentioned the California Journal of Technology, and given the date of it.

The authors of that publication referred to what they use in their test as consisting of a thin ore pulp and oil, and as being agitated, so apparently—

Q. 9. What page are you reading from?

A. Page 36 of the original pamphlet.

Q. 10. Doctor, if I might make a suggestion, wouldn't it be well to make it clearer, to state what these investigators start out with?

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A. Well, yes, I might do that. The authors of this article in the California Journal of Technology head their publication, "Experiment on the Elmore Process of Oil Concentration." And a large portion of the article is devoted to and refers to the Elmore processes, which they have designated as the "Lake effect" in their article, but already in their article on page 36 of the publication they show that they are making experiments on entirely different lines.

Q. 11. Before you go on, state briefly what that Elmore oil process is, and whether it falls in one of the classes that you divided the art into this morning.

A. The Elmore bulk oil process which they are principally discussing and referring to repeatedly under the name of the "Lake effect," is one of those processes which I refer to as an illustration of group four, or class four of the first classification that I made, in which the mineral particles are floated exclusively by reason of the light specific gravity of oil layers into which they are taken, and in which they are carried or suspended. It does not depend upon aeration for the production of air bubbles. On the contrary the production of air bubbles is undesirable and is constantly referred to as to be avoided in the carrying out of the Elmore bulk oil process.

Q. 12. Have you any knowledge as to the amount and kind of oil necessary in the Elmore bulk oil process?

A. By reason of the conditions of flotation there, namely, that the mineral particles are to be carried entirely by reason of the lighter specific gravity of the oil,

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we are dependent there upon the difference in the specific gravity between the oil layer and water, which is a very small difference with the majority of oils, which have an approximate specific gravity of close to .9, as against 1, which is the specific gravity of water. Now, that same buoyancy of the oil is all there is to cause the raising and flotation of the mineral, and therefore it takes a very large bulk of oil to lift the mineral, and the amount has been repeatedly stated as from 100% to 300%, reckoned on the weight of the ore.

Q. 13. That would be about three times the weight of the ore in oil?

A. From one to three times as much as the ore itself weighed.

Q. 14. That would be one to three times the weight of the ore in oil?

A. One to three times as much as the ore weighed.

Q. 15. And as to the kind of oil, as to its viscosity or any information on that line, in the Elmore process?

A. Yes, it has been repeatedly stated that the oil must be a thick, viscous oil, and a petroleum oil is frequently used for that reason. Then we have there a thick and viscous oil, and one which is not readily floured, as it is termed, or broken up by any incidental agitation.

Q. 16. Have you made any experiments on a small scale with the bulk oil process that serves to confirm these views you have expressed as to the character of the process?

A. I carried out the process by rotating a bottle containing the oil and the floating particles and following

exactly the general direction. I carried out the experiment in a bottle and by a number of rotations of the bottle so that the floating particles containing the oil were passed through the oil layer. The oil was caused to take up a considerable quantity of the mineral particles which adhered in suspension, as it might be termed, in the oil layer.

Q. 17. Did you carry out any experiment using the Elmore procedure, but with a smaller amount of oil or an oil that was not viscous.

A. Yes, experiments have been carried out in that way also.

Q. 18. And what was the result of reducing the quantity of oil or in using a non-viscous oil?

A. In a case where kerosene was taken and an oil which was notably less viscous than the other and particularly where the amount was considerably less than this 100 per cent referred to, a froth was formed.

Q. 19. And what about agitation in this Elmore bulk oil process referred to in that original as the Lake effect? The character of the agitation?

A. The authors, on this page, on page 36 of pamphlet, take up that matter.

Q. 20. Have you any information independent of this article regarding this matter of the degree of agitation that is necessary for or injurious to the Elmore Lake effect?

A. Oh, in regard to the Elmore. A very moderate amount of agitation is sufficient to destroy the benefit of the Elmore process because in the first place the oil layer is more or less broken or floured as it is called,

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and that of itself prevents it exercising its floating power, and in the next place the tendency to overcharge as it is termed, soon becomes evident with a very moderate amount of agitation and the mineral drops out so that the Elmore process is distinctly dependent upon the avoidance of agitation, and slow agitation is a particular feature of it. And as I say also the character of the oil is a very important element in this Elmore process and the amount of oil is of course important.

Q. 21. You consider these the three essential characteristics, the large amount of oil, the viscous oil and the avoidance of violent agitation?

A. Yes, sir.

Q. 22. Now, doctor, following the text of this article somewhat, will you explain to us the nature of the investigation of the authors?

A. As I said before it begins with a reference to the Elmore process of oil concentration, and that is explained and a particular plant is referred to and the process of the operation of this plant is also described, including the centrifugal separator which they say was the latest device which caused this process to be more available commercially than it otherwise had been. And they then proceed to the laboratory method. Now, you do not meet anything in that earlier section which bears on the question of froth formation. It is only a discussion of the Elmore process and the various conditions under which it is carried out. But under the head "laboratory methods," which is really on page 35 of the pamphlet—

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Q. 23. What page?

A. On page 35 of the pamphlet we have the following: "In making a test the ore is crushed to a considerable fineness and the proper charge is thoroughly wetted in the solution to be used, usually water, thus forming a thin pulp." So we have the first piece of information—

Q. 24. Before we proceed to that, doctor, I would like to have you explain that a little more in detail, this apparatus for the Elmore process and that method of separating the oil; so that we have it before us.

A. You mean in the earlier part?

Q. 25. Yes, at the very beginning, and that shows a view of the apparatus and on the next page that shows an illustration of the centrifugal separator of the oil which I think you can make clear to us with a few quotations from the text. Well, if in your description, doctor, you will not refer to those numbers because they do not appear on the original and they were put on by a witness, and so do not rely upon identifying anything by those extra letters that were put on there.

A. Well, we have in the first place a reservoir in which the thin ~~oil~~ ore pulp and the oil are introduced.

Q. 26. That is in the upper left-hand corner of the picture on page three—

A. Yes, then we have a cylinder in which a commingling under careful conditions of this ore pulp and oil is to be effected, the commingling being effected there by this slowly rotating screw which causes the oil pulp to be brought into contact with the thick viscous

oil, and yet without too much breaking up of this oil. And then from this it is—

Q. 27. Where is the thick, viscous oil, doctor; where is the oil in that apparatus?

A. The oil goes in from above.

Q. 28. In that vessel showing the screw thread arrangement?

A. Yes, as I understand.

Q. 29. And forms a floating mass?

A. The pulp from the mill is indicated there as flowing in through this tube to the side; thence from that rotating vessel, the mixture comes to rest for the purpose of stratifying and gaining layers. Now, in the upper layer, in the thick viscous oil carrying in it, by reason of its buoyancy and floating power, the mineral, and below that of course is the water and the gangue which is not floated, and any other mineral particles which have not yet been taken up into the oil.

Q. 30. The description of what you have just referred to appears in the second paragraph on page 35.

A. Yes, I am looking for that. The second step of the process is to have again the tailings drawn off at the bottom of the separator, with more oil, for repetition of the treatment, and by means of that there was a separation of the steps, so that the tailings from the first contact of the oil and the flowing pulp are worked again, slowly, with an additional quantity of oil. Now, from the last separator, after the tailings have been worked several times, the tailings are dumped. The mineral-laden oil from this last separator, or from

those separators, is collected together in tank B; that is therefore a collecting vessel in which the mineral-laden oil is gathered, and from that it goes to the centrifugal—however, first at that step it is heated and thinned, to overcome the viscosity, because although that was desirable in the early stages it is not desirable at this stage, and the thinning out of the oil by the aid of heat is desirable. Therefore it is thinned out by heating it, and overcoming the viscosity, and the oil is charged into the centrifugal machines, where the concentrates are separated out by the rapid motion of the centrifugal apparatus.

Q. 31. That is the centrifugal separator illustrated on page 35, is it not?

A. Yes, sir.

Q. 32. You might just refer to that and explain this separation.

A. Well, they dump that material into a basket of perforated metal, which basket is rotated with rapidity, and in that way the heavier material is thrown to the periphery.

Q. 33. That would be what, the heavier material?

A. That would be the concentrate. That is the feature which these young men discuss at some length in the beginning of the article and which they illustrate also somewhat by the illustrations on the following page, figures 1, 2 and 3, as illustrating the centrifugal action. The theory of the separator is illustrated in these figures, 1, 2 and 3.

Q. 34. Now, I wish, doctor, you would explain what

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these writers say under the heading you referred to before, "Laboratory Methods." First quoting the passages you are going to comment on as you go along.

A. We come now to what may be called the original work of the authors of this pamphlet. The prior part of the publication is really comment upon what they had found as stated by others. This pulp used, as I stated a moment ago, is formed of ore and water.

"The oil is next added and the whole charge thoroughly mixed. The mixing or agitation can be done in two different ways; the charge may be agitated very gently, the oil being kept in a single lake and broken up as little as possible consistent with thorough contact of the pulp and the oil." That is obviously following Elmore, and the so-called lake which they obtain is a continuous unbroken layer of oil, which is broken up as little as possible, as stated—as little as possible consistent with bringing the oil in contact, and they note that that operation was performed by that screw working through the cylinder; in this case it is done by gently agitating it in some vessel; the vessel is shown below here; now, the alternative method is given. where the charge may be agitated so violently as to dash the oil up into foam and froth full of ore particles. Thus a very thorough contact of the oil and pulp is obtained. Each method has its advantages and disadvantages and these I will discuss later.

The next section is merely a discussion as to the advantages of using galvanized iron or aluminum or glass, and does not have any particular bearing on the difference in the methods which they employed.

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Q. 35. Beginning down below the illustration on page 36, they seem to take up the discussion again, the three methods of mixing.

A. Yes; three methods of mixing are referred to.

"Three methods of mixing may be used. One. By inverting the tube several times, thus allowing the ore to fall through the oil. Two. By rotating the tube in a horizontal position, thus throwing the pulp up onto the surface of the lake of oil. Three. By violently shaking the tube, thus producing the foam effect, or at least shattering the oil into small globules. The second method named there is practically another way of practicing the Elmore procedure.

Q. 36. What is this tube that they refer to—something like what is shown in the illustration of Figure 5?

A. Yes, I will refer to that when I get through with the other one. The third method is "by violently shaking the tube, thus producing the foam effect or at least shattering the oil into small globules." All three of these three methods of mixing may be carried on in the same tube, which is illustrated there in Figure 5, and that is a nearly cylindrical tube, narrowing at the bottom, and then having an opening. It is very much what is known in pharmaceutical manufacturing as an adaptor, or a percolator; it is really a percolator, by which in pharmacy extractions are frequently made. At all events the lower end of that tube is closed by a cork, and the top of course may be closed by a suitable cap, and that makes it possible therefore to shake up the contents of the tube very thoroughly. The strati-

fication that is shown there will be referred to also later.

Q. 37. They have something to say at the bottom of the page about the solution used in the concentration.

A. Yes; as I mentioned before in an earlier part of my testimony, we have here an indication that they recognize the advantage in using an acid solution.

Q. 38. In what passage does that occur?

A. "The solution used in concentration is a matter of some importance. Water is of course used whenever possible, but certain other solutions have important advantages; as before stated, an acid solution is found advantageous." Apparently they did not know at all of the Everson patent of 1885, in which that was already indicated.

Q. 39. Don't they refer to the Everson patent in the first page of that article?

A. Well, they do; I was wrong about that; they do give credit for that feature in the beginning of the article; they recognize that, and state their reasons. "It cleans the metallic surfaces by dissolving the metallic oxide coatings that may have formed on them. It increases the specific gravity of the solution, and it aids in producing the foam effect, which is due to the generation of certain gases." We have here a condition which is indicated of the increasing of the specific gravity of the solution. That is obviously, as will be seen a little later, a matter which bears on the floating power—the buoyant effect of the oil layer as against

the watery solution of increased specific gravity, in producing the lake effect. On the other hand, it states that it aids in producing the foam effect. That is a use of the acid solution for the direct purpose of getting the froth. They explain that as due to the generation of certain gases. Of course that may be so in fact or it may not, but it is immaterial. The advantage of the acid has been shown, irrespective of the fact of its attacking any metallic material by producing gases, simply in illustrating the selectivity.

The next section deals with the specific gravity of the average oil and shows that either acid or salt will raise that specific gravity of water and of course notably a strong salt solution will raise that specific gravity.

Q. 40. The specific gravity of the water?

A. Of the water in which it is dissolved. They obtain therefore a saturated solution of salt at 20 degrees centrigrade, containing about 27% of salt, thereby obtaining a specific gravity of 1.204. The reason why they are trying to do this is obvious in the next sentence.

"This gives us a difference of .3 between the specific gravities of the oil and of the solution, and a carrying capacity of the oil three-fold greater than with water alone." That has a very important bearing, of course, on the Elmore effect. But we find more than that indicated: "Not only does it give a greater buoyancy to the oil, but it also aids materially in producing the foam effect, and probably aids in brightening the metallic surfaces." So that we have both the action of the acid

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and the action of the strong salt solution indicated, and which in their opinion is desirable for either the production of the lake effect or the production of the foam effect.

The next section on overloading, I think bears entirely on the question of the practice of the lake effect. The question is whether the oil is said to be overloaded, and sinks.

We follow next to the bottom of page 37, with a series of figures giving the results of the experiments with some molybdenite ore. There are six experiments here, which represent one or the other of the two forms of treatment that they carry out. The other three experiments, Nos. 7, 8 and 9, are retreatment experiments; but in the six experiments first enumerated it is perfectly clear that, knowing the amount of ore, the weight of the ore treated and the total amount of the oil, those figures being shown in the second and fourth column—noting those figures we can see at a glance that three of the experiments practically represent the practice of the Elmore method and the other three represent the practice of a method which cannot by any possibility be called the Elmore method, and was designed by them to produce what they call their foam effect, that is, an aerated froth result.

Q. 41. You might refer, doctor, to those relative quantities of ore and oil in the first two experiments, and in Nos. 4, 5 and 6, and tell us what percentages of oil are there stated.

A. The first experiment takes two kilos or two thousand gramms of ore, and 2,400 gramms of oil.

Q. 42. I think if you will refer to the next page you will see that refers to gramms.

A. Yes, it is in gramms. If that is in gramms I will state that again; we get the comparison, then, between the two weights, 2,000 gramms of ore and 2,400 gramms of oil; that is more than 100%. The second experiment takes 2,000 gramms of ore, which is 2 kilos, and 2,000 gramms of oil, exactly 100% per cent of oil. The third experiment takes 1 kilo of ore, a thousand gramms, and 1,200 gramms of oil, the same proportions exactly as in experiment No. 1.

Q. 43. Kg. stands for kilogram?

A. Yes, but kilo is the usual abbreviation.

Q. 44. In Nos. 4, 5 and 6 experiments what would be the percentage of oil relative to the ore by weight?

A. There we have to start with, 100 gramms of ore—those experiments start, of course, with a very much smaller amount of ore, working on a smaller scale than in experiments previously mentioned, but the proportions are the important matter. 100 gramms of ore and 2.1 gramms of oil. That is an amount which is 2.1%, reckoned on the weight of the ore. In experiment No. 5, 100 gramms of ore and 5.3 gramms of oil, or 5.3% of oil. In experiment No. 6, 100 gramms of ore and 8.9 gramms of oil, or 8.9%, reckoned by the weight of the ore.

Q. 45. Now, doctor, if you will follow the text of the following page and explain to us the comments which the authors make on these experiments.

A. "Experiments No. 4, No. 5 and No. 6 show the

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results obtained by treating separate samples with small quantities of oil, in a salt solution and agitating violently to produce the foam effect. This method gives the highest grade concentrate of any of the direct treatments here outlined. In experiment No. 6 only about 10c.c. of oil was used for 100 gramms of ore, making this 8.9 gramms was used for 100 gramms of ore. You have got an extraction of 75% with the concentrates running ~~1~~32.4% of molybdenum sulphide. He says that in the extraction that he used about 10 cubic centimeters of oil.

Q. 46. I notice that on the former page he said 8.9.

A. The specific gravity of that oil, multiplied by 10, would give us the 8.9.

Q. 47. Now what follows that?

A. Well, these concentrates are retreated, and he gives them the results of retreatment, "Samples of concentrate running about 26% molybdenum sulphide from agitating in sulphuric acid solution fifteen minutes."

Q. 48. Is this retreatment or reagitation of the concentrates in accordance with anything you know in the present practice?

A. It is current practice, as I understand, almost universally, and reconcentrating.

He goes on to state this agitation caused considerable occluded gangue to free itself. That of course is the desirable thing and is the object for which all reconcentration is practiced. A small quantity of oil was then added and the material reconcentrated, but there

is the froth effect—that means the small quantity of oil, and vigorous agitation. In No. 9 a concentrate running as high as 50.02 molybdenum sulphide was obtained and the remark is then made that the concentrate such as this would probably be merchantable.

Q. 49. Can you point out a passage in this article where the authors described in particular the characteristics of this foam or froth effect?

A. That is found in a summary which is the last portion of the article, in a summary, a resume, the following suggestion and inferences are obtained. The first "As regards the wetted pulp" and is a matter of theorizing; so is the second paragraph and the third, but we have a separate paragraph headed specially "foam effect," in which their views as to the results they obtained by violent agitation are stated. "The foam effect is produced by a violent agitation, especially in acid or salt solutions."

Q. 50. On page 41 you are reading, is it, doctor?

A. That is page 41 of the article and the very last of the whole page. "This throws the oil into a froth, which is heavily charged with air or other gases. This gas of course gives a greatly increased buoyant force. The oil in this condition assumes a certain load of mineral and holds it in a very stable condition. The charge does not settle and overload on standing as in the case of the Lake effect." Here is a very significant contrast between the results of the foam effect and the results of the Lake effect, expressed in several results. With regard to the stability with which mineral is held

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in the foam—in other words, a stable froth holding mineral without dropping it for considerable periods of time; and the statement, too, that the charge does not settle and overload as is the case of the Lake effect or the Elmore bulk oil result, where overloading is one of the matters which they are constantly advising against, or constantly cautioning rather, against. It seems to be this summary and statement there about the foam effect shows very clearly that they understood the various essential matters of the difference, and that they correctly describe an aerated froth; under this name of foam, an aerated mineral laden froth.

Q. 51. Do these other topics on page 38 giving "copper ores" and "copperopolis ore"; 39 "gold ores"; Tuolumne ore; forty "Folsom ore" or do these passages have any reference to the froth or foam effect?

A. They do not appear to have reference to that. We have under that heading "copper ore" the gentle agitation referred to."

Q. 52. Now, I would like to ask you, doctor, whether with the quantities of oil stated in experiments four to nine inclusive, page 47, what the effect would be if one attempted to produce the Elmore bulk of oil or Lake effect?

A. You could hardly get any appreciable result by practicing the slow, gentle movement of the Elmore method with this insignificant quantity of oil.

Q. 53. In what respect do you find this investigation contrasted there from the ore froth effect like the Lake effect?

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A. They say here that this method, referring to the violent agitation method, gives the highest grade of concentrate of any of the treatments given therein and that is illustrated in the tabulation.

Q. 54. You refer more particularly to the procedure and the substance used?

A. I don't quite grasp the point of your question.

Q. 55. I will restate the question. In what respect did these investigators describe their process as different from the Lake effect or the Elmore bulk ore process?

A. They refer to it as being a process which, while ready of execution and using this relatively trifling amount of oil, is capable of giving superior results and of bringing about by retreatment, marketable concentrate.

Q. 56. In the matter of agitation, how do they describe their process as compared with the Lake effect or the Elmore process; the same agitation or a different kind of agitation?

A. It is of course a totally different agitation and is and in the very earliest mention of it they state: "Thus a very thorough contact of oil and pulp is obtained." That is very distinctly superior of course to the possibilities of contact by the slow rotation or slow turning of the Elmore process. It rapidly or thoroughly puts the ore in contact with the oil and with the product of the air bubbles which become coated, forming the froth.

Q. 57. Can you have a demonstration here—that

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process on a small scale performed, or perform one this afternoon?

A. I understand that it can be done, and it can be demonstrated. Mr. Dosenbach will demonstrate it.

Q. 58. I have asked Mr. Dosenbach to get the material. Will you describe the demonstration which you propose to have him to do for us following the lines of this article?

A. It simply consists in taking a cylindrical—a tall, cylindrical vessel approximately of the general shape of the percolator shown here and introducing the flowing pulp and the amount of oil corresponding by weight to one of the other of the several percentage figures which are given here in experiments 4, 5 and 6, and then stopping the mouth of the vessel with a cork, giving it a violent agitation and shaking it and almost immediately we have the appearance of the foam referred to by the writers, or an aerated froth. It is instantly recognizable as mineral carrying and in other words as a stable froth produced by air bubbles coated with mineral sulphides, and at the bottom of the vessel are seen the tailings of different color and appearance from the mineralized form.

Q. 59. And to what is the flotation due in this process; what does the buoyancy come from?

A. What?

Q. 60. What is it gives the buoyancy to the float in this process?

A. It is entirely due to the air bubbles which are produced by reason of violent agitation, and which as I

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say in the presence of this small amount of oil have a selective action and become mineral coated and give us therefore a mineralized froth, as it is termed, made up of air bubbles with mineral coating and mineral sulphides deposited upon them.

Q. 61. Have you heard some of the testimony here regarding mill operations with quantities of oil running upwards of two per cent and higher?

A. I heard what was testified here.

Q. 62. And will you compare such mill operations with the process described, in that particular?

A. We have the same elements present, of procedure, we have the taking of the thin ore pulp, an amount of oil which is small and approximates one of the illustrations mentioned by these writers, namely, in experiment No. 4, and we have the violent agitation brought about by the rotating blades of the agitator, and if the process was to be intermittent as in a single vessel such as we have here in the percolator, the froth would rise on stopping the agitation in that vessel. In practice it is considered more desirable to carry on the process as a continuous process rather than intermittently and in that case the froth passes over and is caught in the adjacent separating box called the spitzkasten over the edge of which it flows.

Q. 63. Now, referring to the operations which have been described here and carried out in the mills with one per cent and less of oil, will you compare such operations with the process described in this article.

A. With one per cent?

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Q. 64. Yes, with any quantity down to the minimum that has been described or the maximum for that matter. Do the remarks you have made apply?

A. There is no difference in principle whatever. The amount of oil can be varied within considerable limits, as far as I have observed, and I see no reason why, from any knowledge of the matter that I have, it should not vary within very considerable limits, and form a froth in which the air bubbles and the oil film coating and the selected mineral sulphides make up the result as the mineralized form?

Q. 65. Now, test No. 1 doctor, if you will just state the substances that are to be used in this experiment I will get Mr. Dosenbach to come in and help you perform it?

A. This is as I understand it to be a demonstration of experiment No. 5 as described in this article in the California Journal of Technology, experiment No. 5, taking one-half quantities. Instead of 100 gramms of ore treated, we start with 50 gms. of ore and we wet—and instead of the 5.3 grams of oil we use 2.17 I believe. The ore is molybdenite sulphide, as is the case in the experiment described in this article.

Q. 66. Which is it you are to repeat, No. 5 or No. 4?

A. I understand example No. 5 is the one we are to carry out.

Q. 67. That is you have an amount of oil equivalent to 5.3?

A. Yes, but we will divide that in two, this being 2.65 grams. The oil taken is fuel oil, California fuel

oil, 2.65 grams, 150 c.c. of water, that is three times the amount of water and about four-tenths of a cubic centimeter of concentrated sulphuric acid.

Q. 68. Now, Mr. Dosenbach is ready.

MR. WILLIAMS: Is the mesh of the ore given; what is the mesh of this ore?

MR. SCOTT: This experiment says 30 mesh. We ought to know it. Do you know, doctor?

A. That is what it says here in my memorandum was used, 30 mesh.

MR. WILLIAMS: And of course you will give us a specimen so that we may put it through a screen analysis. And we arranged at the Wilmington trial the way to make these tests was to fix them up and divide them equally, not to have something given out and said to be something like something that you used.

MR. SCOTT: All right, we will let you have a quantity of that. You may divide it into four parts and then you may proceed with what he leaves, to do your experiment.

MR. WILLIAMS: We adopted that in our nine weeks' trial.

MR. DOSENBACH: I prepared for Mr. Williams ahead of time so we can do that.

MR. WILLIAMS: What temperature of water do you expect to use? It seems to be very hot. You didn't tell us.

A. No.

MR. WILLIAMS: What temperature do you propose to use?

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A. I don't know what was used at Wilmington, I don't recall.

MR. WILLIAMS: Well, there is nothing in there about hot water at all?

A. No.

MR. KREMER: Drop your thermometer in and take it.

MR. DOSENBACH: 150 cubic centimeters of water, doctor.

MR. WILLIAMS: At what temperature please?

MR. DOSENBACH: 40 degrees.

MR. WILLIAMS: Forty degrees C.?

MR. DOSENBACH: Centigrade.

MR. WILLIAMS: That is 104° F, is that right, doctor?

A. I can make the calculation. You are going to put the fuel oil in by measure?

MR. DOSENBACH: I am going to drop it out. I have determined how many drops were equal to 2.65 grams. That is the best way to handle this. 75 drops.

(Witness drops 75 drops of oil into the mixture.)

MR. WILLIAMS: I think it should be noted that the amount of oil used is 75 drops?

A. That is down in the record.

MR. WILLIAMS: How much acid?

MR. DOSENBACH: Four-tenths cubic centimeter.

MR. SCOTT: Let the record show that it was shook for fourteen seconds.

MR. GARRISON: What kind of acid was used?

MR. DOSENBACH: Concentrated sulphuric acid.

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Q. 69. MR. SCOTT: Now, doctor, will you describe the result of this experiment?

A. The results of this experiment, using the amounts which have been put upon the record and which illustrate the fifth experiment on page 37 of the publication are that we have produced a metallized aerated froth in which the air bubbles are the direct cause of the rising of the mineral and there is practically all of the elements in that that we have in the class known as agitated froths. We have the difference in color clearly indicated between the froth layer and the layer of gangue. It is clear now that there is still more in the gaugue and retreatment would be probably very desirable and would be ordinarily practiced. We don't have, in other words, a clear tailing as the thing is now; the tailings would have to be retreated, but that of course is current practice as I say, and with such retreatment it looks to me from the indications as almost certain we would have an excellent separation.

Q. 70. You are familiar with the process of flotation as carried on by most of the large companies are you not, the Butte & Superior and the Utah Copper?

A. I have seen it carried on in a large scale in the mills of the two companies, the Butte & Superior Company and the Utah Copper Company at Salt Lake.

Q. 71. Barring the difference between agitation in a tube and bottle and agitation by mechanical agitators, bearing that difference in mind, what essential do you find that this operation, carried out in this experiment, differs from or resembles the large scale operation?

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A. It has, as I said before, all of the elements of the process that were carried out in the large scale operations, remembering that in—that this is a so-called intermittent operation that was carried on here, stopping. And when the agitation stops the froth has to rise in the vessel in which the agitation is carried on by shaking. In ordinary practice that is different in appearance because the agitation is going on continuously and the froth is rising at the same time in the side vessel, the so-called separating vessel or spitzkasten and being taken off continuously. That of course cannot be carried on with an intermittent operation as we have here; but the principle of the two is practically the same.

Q. 72. Are you familiar with the bottle test that has been described by the witnesses in the Hyde record which is now a part of this case?

A. I have seen it carried out, and remember the test.

Q. 73. I would like to read the description of that bottle test to you.

MR. WILLIAMS: There is one detail; I don't know what oil was used in that experiment. I did not get a sample of that oil, I think.

MR. SCOTT: I think you got one.

Q. 74. He claimed the oil was a fuel oil, wasn't it?

A. I heard it stated here that this was a fuel oil.

MR. KREMER: I am informed that you were furnished with a sample of that oil; it is called Smelter Fuel Oil.

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Q. 75. I would like you to compare this operation under the conditions of the California Journal of Technology article with the description of this operation made by Mr. Chapman, one of the previous witnesses, who testified in the Hyde case, page 208: "Q. Did you ever make any tests of the operations set forth in the patent in suit by performing those operations in a bottle or test tube?

A. Yes.

Q. 76. Will you describe how you did it?

A. I would take a bottle of the capacity of, say, roughly, 100 cubic centimeters, and in it place 20 grams of ore and 70 grams of water. To this I would add sulphuric acid, equal roughly to 20 pounds of acid to the ton of ore. To this I would add oil by the drop equivalent to one and a half or two pounds of oil to the ton of ore, and agitate vigorously." That is the description of the bottle test which I would like to have you compare with the operation just performed in court.

A. The principle of the two tests is the same—or of the two experiments. If the former be carried out we have here a slightly larger vessel. This is 250 c.c. graduated vessel, and the other was described as a bottle containing about 150, but that is an element of no importance in effecting the operation. We have the corresponding conditions of the ore in a thin pulp with the amount of water mentioned and the oil, and some form of agitation as we carried it out.

Q. 77. Now at a later stage of the trial, doctor,

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when we have our apparatus ready and set up in the court room here, can you have repeated for us this same operation upon a larger scale?

A. I expect to do so. I had not finished the part of my answer that I started on this morning, in which I have spoken of the foam effect found in the prior record, and following this California Journal of Technology, I was going to go on and refer to Kirby.

Q. 78. You may do that, doctor.

A. Yes. I shall continue that showing the anticipation of the foam claimed in the patent in suit by additional citation of priority, if you will turn to the Kirby patent, No. 809,959.

Q. 79. Very well.

A. In this Kirby patent we have a violent agitation specified, not only in the specifications, but practically in all of the claims, with an apparatus that it can be shown entrains air. That is, I refer to the rotating arms of this apparatus shown in operation in Figure 1, and shown in detail of construction in Figure 4; resulting in the production of an air froth, and as a supplemental step in the Kirby process, there follows the blowing of air or other gas in at the bottom, with a gentle agitation to loosen additional trapped mineral particles, and throw them to the top for air flotation. That feature is again carried out in the patent in suit, where there is a supplemental process involving the introduction of air without the violent agitation, as a supplemental step in bringing more of the mineral to the surface. In the Kirby process there is produced,

as stated in the Kirby patent, a floating scum; a floating hydro-carbon concentrate.

Q. 80. What pages?

A. I find this in lines 79 to 88, page 1 of the patent. I will quote:

"Second in allowing the hydro-carbon coated particles to float to the surface of the mass and render the separation substantially complete by gently agitating the mass and by injecting gas into the same, and preferably, also discharge into the mass fine streams of the solution. When the separation is completed, the floating hydro-carbon coated concentrate is removed for subsequent treatment."

There is also described in full detail in Kirby's patent at a subsequent step, the action of a skimming appliance, which skims off the floating concentrate.

Then again we have in the Kirby patent on page 2, line 66, the following as illustrating the second step of the process:

"The air bubbles not only do not attach themselves directly to the coated particles and then throw them to the surface, but the air becomes dissolved in the water to its maximum capacity. This dissolved air tends again to separate itself from the water and attach itself in minute globules to the coated particles."

We have here almost exactly the explanation of the second procedure of the patent in suit, in which, air having been dissolved under pressure in the water, when the pressure is relieved that air escapes and operates in the same way to float the particles to the

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surface, and of course forms more or less of an air bubble concentrate—a mineral-covered air bubble concentrate. I consider that in the Kirby patent we have therefore an agitation air froth, followed by the supplemental production of a secondary froth by direct aeration, which is very much the counterpart of the patent in suit; primary agitation and secondary aeration.

Q. 81. Upon page 3 of the Kirby patent, No. 809,-959, that is page 745 of the volume as my copy is numbered—line 37, I see the statement: "Rotary movement of the charge lea~~ves a~~ ds the floating scum of hydro-carbon liquid air bubbles and concentrates against the curved skimming bar." etc. What signifiicance do you attach to that passage, doctor?

A. We have there the taking off of an aerated froth, which is made up, as stated here, of the hydro-carbon liquid, air bubbles and concentrates. That means air bubbles coated with hydro-carbon liquid, and carrying on their surface a concentrate coating or the mineral sulphide coating, which, together, gives us the mineralized froth from which the concentrate is obtained.

Q. 82. In the patent in suit, No. 835120, the statement is made that it is by reducing the amount of oil below or to a fraction of 1% that this floating froth is obtained. Do you know of any patent issued to any of the grantees of patent No. 835120, in which any statement occurs regarding the amounts of oil which can be used for this same purpose?

MR. WILLIAMS: That question is objected to because it contains an assumption that is not founded on fact. Please quote the language of the patent, and do not state something which is not there.

MR. SCOTT: My question was fair, I think. If you will point the particular error I will try and correct it.

MR. WILLIAMS: The beginning of it.

THE COURT: You are stating something which they claim the patent does not contain, so you had better quote that patent.

(Question withdrawn.)

Q. 83. In the patent in suit in the paragraph beginning with line 16, page 1, reference occurs to a certain Cattermole patent, together with the statement that in the progress of the Cattermole process —"an amount of oil varying from 4% to 6% of the weight of the metalliferous matter present is agitated with an ore pulp so as to form granules—" In the following paragraph is this statement: "We have found that if the proportions of oily substance be considerably reduced, say to a fraction of one per cent. of the ore, granulation ceases to take place, and after vigorous agitation there is a tendency on the part of the oil-coated metalliferous matter to rise to the surface of the pulp and to form a froth or scum." Now, I will ask you, doctor, whether any of the three grantees of this patent have, in any other patent that you are acquainted with, made any statement in

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regard to the possibilities of obtaining these froths with the quantities of oil greater than one per cent?

A. I have found statements bearing on this matter in United States Patent 835143, issued to Henry Sulman, which patent is found on page 419.

MR. WILLIAMS: That is not the record that the court has.

Q. 84. Page 749 of the printed record?

A. Yes. This patent to which I just referred was applied for a year and a half after the application for the patent in suit, of which the same Henry Sulman was one of the alleged inventors.

Q. 85. How long after did you say, doctor?

A. It was applied for on October 20th, 1906.

Q. 86. The figure is poorly printed. Is that 1906?

MR. WILLIAMS: It was applied for October 20th, 1905. It was issued in 1906.

A. Well, then, it was applied for six months after the patent in suit; I could not read the figure there. That was April 29th and this is May 20th. It was applied for some six months later than the patent in suit, and by one of the patentees of the patent in suit. We find in this patent, 835143, on page 1, line 53 to 59, the following:

"The quantity of oil employed is not sufficient to cause the flotation of metalliferous matter by the buoyancy of the oil, but the quantity may be sufficient —say 5% or less on the quantity of the ore—to coat the metalliferous particles with a thin film of oil."

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Now, a mixture under these conditions, and with this amount, mixed in a cone mixer—here is that in lines 66 and 67:

"The mixture is agitated in a cone mixer or the like." And it may be heated in this cone mixer or a separate vessel. The element of heat is an important matter in this particular patent. It may be heated in this cone mixer or in a separate vessel, and the result of this treatment was stated, and this amount of oil was stated in lines 73 and 76 as follows:

"A froth or scum rises to the surface, containing practically the whole of the metalliferous matter, while the gangue remains in the pulp. This froth may be skimmed off, or allowed to flow from a spitzkasten."

Again, in lines 76 to 81, showing that it may be skimmed off in the vessel in which it is generated, or taken off in a separate vessel or spitzkasten.

If we turn to the claims of this patent No. 835143, particularly in the last claim, we have information that is important. The last claim of the patent is as follows:

"The herein described process of concentrating ores which consists in finely powdering the ore, mixing it with water containing less than one per cent. of sulphuric acid, adding a proportion of less than 10% oleic acid, agitating the mixture until the oleic acid has come into sufficient contact with the mineral, heating the mixture up to boiling point, until the metalliferous matter has been raised in a froth to the surface; running the mixture over a current of water so that

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the froth is floated away by the current, while the remaining mineral sinks; separating the froth and removing the oleic acid therefrom by a solvent." The bringing of the mixture up to the boiling point, as stated here, is shown to be a vital feature, but we have on page 1, lines 96 to 100, a statement which somewhat qualifies that:

"All the contents of the agitation vessel may be heated to the necessary extent which approaches the boiling temperature and by cessation of the agitation the mineralized froth rises to the surface."

Q. 87. In the process of this patent 835,143, I wish you would compare what you have just read as to the cessation of agitation and the froth rising to the surface —compare that with the patent in suit with reference to that particular phase of it. Why does the froth rise in the process in the patent in suit?

A. Following agitation; we have that described in the patent in suit, beginning line 31:

"After vigorous agitation there is a tendency on the part of the oil-coated metalliferous matter to rise to the surface of the pulp in the form of a froth or scum."

Q. 88. Then in line 89 of the first page of the patent in suit?

A. We have the thing again stated:

"When agitation is stopped a large proportion of the mineral present rises to the surface in the form of a froth or scum."

Q. 89. Then in patent 835,143 we have the statement which you just read on page 1, line 99?

A. Yes, line 99.

Q. 90. Read that expression again, will you?

A. "And on cessation of agitation, the mineralized froth rises to the surface."

(Recess.)

Q. 91. Before we proceed any further, doctor, I did not notice whether the court was shown the appearance of the top of that froth in the test tube, by taking the cork out.

A. I have observed it.

Q. 92. I would like to have the court look at the top of that to see the distinctive appearance.

THE COURT: What is the distinctive feature?

MR. SCOTT: It is to compare it with others which we will show the court later. I do not know that it is a very convenient vessel for the court to see it in.

(The court examined the bottle or test tube containing the ore and froth.)

Q. 93. The froth and tailings are now separated are they not, by comparatively clear water, and the tailings have practically all settled, haven't they?

A. They seem to have settled out almost entirely.

Q. 94. What, if any difference in appearance do you notice between the floating froth and the settled tailings?

A. I believe I stated before that the froth was of such a color as to indicate the presence of mineral sulphides and the presence of mineral sulphides is recognizable also when you look closely at the froth either

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from the side or looking down upon it, and of course you recognize the froth structure, the air bubbles; they show very clearly, and the whole effect of the froth here as looked at from above is that of the so-called coated armor plated, aerated froth produced by agitation. On the other hand the tailings—those which first settle—are relatively lighter— notably lighter—and they are rather darker as you get to the top. And looking at the separated layers, it is evident that the tailings would probably have to be reconcentrated to recover from them the values which are now remaining in them.

Q. 95. I think I will ask you next, doctor, to explain to the court the process described in the Everson United States patent.

MR. WILLIAMS: Mr. Scott, how long is that specimen going to be preserved?

MR. SCOTT: It depends on the wishes of the court and counsel.

THE COURT: As far as the court is concerned, there is no occasion to preserve it unless some of you want it preserved for some reason.

MR. WILLIAMS: I was wondering whether it would not be better—I don't want to interrupt the examination, but I was wondering if I had not better make a little cross-examination on that now, since this is something that is going to be evanescent, here today and gone tomorrow.

MR. SCOTT: I have no objections to your interrupting the examination.

THE COURT: Yes, you may cross-examine.

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CROSS-EXAMINATION.

BY MR. WILLIAMS:

Q. 96. Does not that float look like a magma?

A. It looks like a magma in some degree. In fact I have repeatedly seen aerated froth resembling a magma. I do not take the name magma as excluding the presence of air.

Q. 97. What do you take it as indicating?

A. A magma is different from an emulsion, in that it is more of an open type of mixture and allows of the sponginess which would be due to the presence of air. You frequently see magmas produced after agitation in very many operations—what are described as magmas, and I have associated it in my mind—the word magma—more with a heavy, dense-looking froth, than I have associated it with the mere emulsion mixture of liquids.

Q. 98. A magma is defined as a paste, isn't it, in the Standard Dictionary?

A. It is described as a thin paste; that is a definition which I heard quoted from a dictionary in the testimony.

Q. 99. Although the California Journal of Technology says these experiments were carried on with a salt solution, you carried them on with a sulphuric acid solution?

A. Either sulphuric acid or salt; the particular ones which are there given with the results, were made with salts.

Q. 100. That is, the experiment that you pretend to

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repeat was made with a salt solution and you repeat that with a sulphuric acid solution?

MR. SCOTT: I object to the question. There was no pretense that this repeated any individual and particular operation. The quantities were taken from the tabulated statements, and the description was that it might be performed with either a salt solution or an acid solution, and the witness will make it in any kind of solution that counsel wants.

THE COURT: I think it ought to be made clear on the record. The question is proper enough. The objection will be overruled.

A. The experiment was carried out with sulphuric acid because the general principle of producing the foam effect was clearly stated by the writers to be carried out by them either in an acid solution or in a salt solution. The particular experiments which are there enumerated in the tables were carried out with salt solution, so I did not attempt to make the experiment here to carry out anything more than an illustration of the principle, and I did not state that we were following literally everything that was stated as to the experiment cited in that summary.

Q. 101. Then this experiment was carried out at 40 degrees Centigrade and 104 degrees F.?

A. 104, yes.

Q. 102. And do you find any statement in the California Journal of Technology of the use of heat?

A. No; that is not referred to.

Q. 103. And isn't it characteristic of the Elmore

process, to which the article refers, that heat was not to be used?

A. Heat is undesirable in the carrying out of the Elmore viscous oil effect, yes.

Q. 104. Because it thins the oil?

A. Yes.

Q. 105. And causes it to drop the mineral?

A. There is no point to it in the understanding of the principle of violent agitation, and I did not find any particular caution with regard to keeping down the temperature to a low temperature at all referred to in this article.

Q. 106. In fact you found nothing in the article which told you to use heat?

A. Bearing on that subject.

Q. 107. And yet you used heat?

A. It was used as a warm solution—slightly warm, yes.

Q. 108. And I presume you used it because you had to use it?

A. I don't think so; I think it can be done at ordinary temperature and I think I have done it at ordinary temperature, and I am ready to try it at ordinary temperature.

Q. 109. You are ready to try it at ordinary temperature and with a salt solution?

A. Yes, sir.

MR. WILLIAMS: I think the experiment is wholly irrelevant to be in evidence in this case, if your honor

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please, since it is shown that he has departed in two very important particulars.

THE COURT: I thought he was repeating the experiment. He has nothing to say about that. I thought it was experiment No. 5; but at the same time it will be allowed in, and it will be a matter of argument. I do not understand that you have made any objection. You can argue it from your standpoint and they can argue it from theirs. You may proceed.

MR. WILLIAMS: Of course it is in evidence only as an interesting experiment.

Q. 110. BY MR. SCOTT: Do you find in the California Journal of Technology a reference to the production of foam and froth in an acid solution as well as in the salt solution?

A. Certainly I did.

Q. 111. In your previous testimony in which you stated that the use of heat was objectionable, were you referring to the Elmore lake effect or were you referring to the process advised by these investigators, using a small amount of oil and violent agitation?

A. I was referring solely to the lake effect, because there the influence of heat has been repeatedly shown to be undesirable, because the most viscous oil is there desirable in the Elmore work, and heat, of course, reduces the viscosity and promotes fluidity of the oil.

Q. 112. And in the foam or froth effect is it your experience that viscosity is necessary?

A. It makes no such difference, and the slight advantage in viscosity of the oil, conducting it at 40° C.

or taking it at about 22° C., which would be the ordinary temperature of this room, would not, to my mind, make any difference in the agitation process.

Q. 113. Can you refer to the passage, doctor, in the California Journal of Technology that you just mentioned which has reference to the use of the acid solution as well as the salt solution?

A. The two are put exactly together as alternatives in the resume under the head of "foam effect."

Q. 114. "The foam effect is produced by a violent agitation, especially in acid or salt solution."

MR. SCOTT: Before passing to the next subject, I would like to wait a moment and have this experiment repeated in a salt solution; it might save time, doctor, if you are ready—well, they do not seem to be quite ready so I might as well proceed.

Q. 115. You may proceed, doctor, with the discussion of the Everson patent, and when you get to a convenient stopping place you can have this experiment repeated. It appears on page 607 of the Hyde record.

THE COURT: The patents that you are discussing are all in the Hyde record?

MR. SCOTT: Practically all of them. Those which are not I will hand to the court separate copies.

THE WITNESS: Shall I go on?

Q. 116. Doctor, I hate to interrupt you again, but there was another matter with reference to Patent No. 835,143 that you were discussing before recess that I would like to ask you about. In the paragraph beginning at line 15 of Patent 835,143 on the first page, and

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the following paragraph beginning on line 30, reference is made to an application, Serial No. 262,889, and upon reference to the patent in suit you will find that that is the number of the application for the patent in suit. In view of that fact I would like to ask you what significance you find in those two paragraphs beginning at lines 15 and 30 of the patent 835,143.

A. We have clearly shown in the paragraph beginning line 15 that in the process described in the specifications of that serial number there stated, 262,889, which I find on examination is the application for the patent in suit, 835,120. We have stated there that a mineral pulp is agitated with a small proportion of an oily substance, such as oleic acid or petrol, or other oils, amounting to a fraction of one per cent, until the oil-coated metalliferous matter forms into the froth which can be separated by flotation. With that is contrasted the statement beginning on line 30 in Patent 835,143, which is, "It is now found ——" The basis of this independent discovery— "It is now found that the finely powdered ore has been suspended in water, and is mixed with a small portion of oily substance, say 5% or less—the tendency of which is that the formation of the froth containing the mineral matter is considerably promoted." Greater separation of the mineral matter from the gangue is secured. The result thus claimed is described: "Substantially all of the metalliferous matter is thus raised in the form of a froth." In line 74, and "practically the whole of the metalliferous mat-

ter is raised under these circumstances with 5% of oil."

Q. 117. Does the statement that the formation of the froth containing the oily coated metalliferous matter is considerably promoted—does that indicate any relation between the process of 835,143 and that of 835,120 or not?

A. Well, in patent 835,120 we had a tendency stated as the result of certain steps. Here we have a statement that the formation of froth is considerably promoted; so that the language is probably no stronger in one specification than the other.

Q. 118. Do you find in No. 835,143 where the float is referred to as a froth—do you find any attempt to distinguish between the froth formed by the process of patent 835,143 and that formed by the process of patent 835,120, in structure or in efficiency?

A. We have in this patent 835,143, remaining among the claims the statement of the supplementary removing of the oil and the mineral after the separation has been effected. That is no longer found in the patent claims of 835,120, although the file cover indicates, I believe, that it was contemplated?

Q. 119. The removal of the oil?

A. The removal of the oil from the concentrate.

Q. 120. Well, I would like to refer you to the patent in suit, 835,120, page 2, lines 3 to 8?

A. I see it is not eliminated. I see it also in some of the claims of the patent 835,120 and in—in claim 8 for instance.

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Q. 121. Just read the part you refer to of claim 8, the patent in suit?

A. There, the supplementary removal of the excess is referred to.

Q. 122. In what words?

A. "Filtering off the froth and removing the oleic acids therefrom by treatment with an alkali." We have instead of this the use of a solvent taking the acid off, in patent 835,143.

Q. 123. Do you find any material difference in describing the removal of oil between the two patents?

A. The alkali would be the more active probably than the solvent, as a practical matter.

Q. 124. Well, now, doctor, may I interrupt you once more to repeat this experiment, which can be done in salt solution at ordinary temperature.

THE COURT: Mr. Scott, this record you have given me, is that from this court to the Circuit Court of Appeals?

MR. SCOTT: The record you have was printed for this court; we printed the record in this court as well as in the Court of Appeals. We narrated it in the court above.

THE COURT: I suppose these same patents were taken up to the Supreme Court in the record you have indicated to the doctor?

MR. SCOTT: Yes.

MR. WILLIAMS: Everything there that has been referred to except the California Journal of Technology was taken up to the Supreme Court of the United States?

MR. SCOTT: Possibly it might expedite matters a little if we excuse the doctor and let Mr. Dosenbach testify directly as to what he is doing and the temperature of the solution and so forth.

THE COURT: Take your own course, whatever seems best to you.

MR. SCOTT: I think that will be best. It will simplify the record. Mr. Dosenbach may be recalled for the time being and he can tell us what he is doing.

BEN H. DOSENBACH, recalled in behalf of the defendant, testified as follows:

DIRECT EXAMINATION.

BY MR. SCOTT:

I have here a saturated salt solution. The temperature of this 18°, I take it, Centigrade. After placing the thermometer in the salt solution I find that it is 19° C. I have now placed into the glass graduate 150 cubic centimeters of the salt solution, and I will now add 50 gms. of the molybdenite ore.

Q. 72. You are using the same ore that you used in the experiment with the acid solution?

A. The same ore or a sample of the same ore as I used it with the sulphuric acid solution. I will now drop in a sample of the same oil as previously used in the experiment where sulphuric acid was used, amounting to 75 drops of oil, this being the same oil as was used before, what is known as smelter fuel oil, the

Ben H. Dosenbach.

amount, 75 drops being equivalent to 2.65 gms. or 5.3 per cent relative to the ore used. I will now agitate for fourteen seconds.

MR. GARRISON: What happens if you leave the cork in? Does it make any differnece if you leave the cork in?

A. None at all. After agitating for a period of 14 seconds a froth is formed of greater volume than that which was formed when using sulphuric acid.

MR. SCOTT: Do you know any reason for the greater volume of the froth in the salt solution experiment?

A. The reason for that would be due to the salt solution producing more of a foam or froth effect, as will be noticed by reference to the agitation of the salt solution itself, which I am now shaking, and a forth or foam forms on the surface.

MR. SCOTT: The witness agitated a bottle containing saturated salt solution and nothing else.

Q. 73. What was the effect of that agitation upon the salt solution?

A. The effect was that a froth was formed on the surface.

Q. 74. And what about the appearance of the water itself, beneath the foam?

A. It is somewhat dense and cloudy, showing the presence of air within the water itself.

Q. 75. Would that same thing take place if you were to shake a dilute solution of sulphuric acid, which was used in the first experiment?

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A. That same thing would not take place.

Q. 76. And it is to the properties of the salt itself then that you attribute the greater volume of froth in this second experiment than in the first?

A. I do.

Q. 77. Does the temperature have anything to do with it; the lower temperature in the second experiment as compared with the first?

A. From the results obtained I would say that it doesn't have anything to do with it, the temperature being lower with the salt solution produced a more voluminous froth than that which was produced at 40° when the sulphuric acid solution was used.

Q. 78. Was this a viscous or thin oil that you used? This smelter fuel oil, in this experiment?

A. A viscous oil.

CROSS-EXAMINATION.

BY MR. WILLIAMS:

X-Q. 79. What kind of salt did you use and what proportion in order to obtain a saturated salt solution?

A. Ordinary sodium chloride, or common salt, I used the proportion as indicated in the California Journal of Technology, which is marked on here, in order to make up the same proportion.

X-Q. 80. Just for the record what is it; you say it is marked on the bottle?

A. It is a saturated salt solution having a specific gravity of 1.199 at 15 degrees Centigrade, the specific gravity equals 23° Be.

Ben H. Dosenbach.

RE-DIRECT EXAMINATION.

BY MR. SCOTT:

R-Q. 81. Mr. Dosenbach, you helped Dr. Sadtler in that first experiment, performing the real operation for him, did you not?

A. I did.

R-Q. 82. Now, will you just state the quantities of the different ingredients you used and the time of agitation, and so forth?

A. In the experiment where sulphuric acid was used, which was the first experiment I performed for Dr. Sadtler, I used 150 c.c. of water at a temperature of 40° C. I next added 50 gms. of molybdenite ore and next added 75 drops of fuel oil, equivalent to 2.65 gms. or 5.3 per cent relative to the ore used. I next added four-tenths of a cubic centimeter of sulphuric acid. I then agitated this total mixture for a period of fourteen seconds upon which a mineral froth was formed, being about one and a quarter inch to one and a half inches in thickness.

R-Q. 83. You had previously determined, I presume, that the 75 drops of that particular oil amounted to 2.65 gms.?

A. I had previously weighed out 75 drops from the same beaker.

R-Q. 84. What was your purpose in dropping it out by drops instead of measuring it and pouring it in?

A. The oil being viscous I could not determine just how much I used had I poured it out.

R-Q. 85. You mean it would stick to the measuring vessel and you could not pour out the quantity you measured?

A. It would stick to the measuring vessel or any pipette or burette I may have used.

R-Q. 86. The method by drops you adopted for accuracy?

A. I have.

RE-CROSS EXAMINATION,

BY MR. WILLIAMS:

RX-Q. 87. In regard to the mesh of the molybdenite ore. I do not think we have that there stated?

A. That was crushed through 30 mesh.

RX-Q. 88. Crushed to 30 mesh?

A. Through 30 mesh.

RX-Q. 89. Did you make a screen analysis of it?

A. I have no screen analysis of this particular ore, Mr. Williams, other than I sent it to the laboratory to have it crushed through 30 mesh.

RX-Q. 90. And I do not believe the ore has been described. Can you describe it with any certainty?

A. Well, I can describe the ore as being a molybdenite ore containing about two per cent $Mo\ S_2$, molybdenum sulphide, and about four or a little more than four per cent of iron, determined as ferrous oxide.

RX-Q. 91. That is ferrous oxide.

A. That is ferrous oxide, and the balance—I can supply you with an analysis of it if you so desire, but I have it with me, and that is the best of my recollection.

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RX-Q. 92. Let us have the analysis later?

A. I will.

MR. SCOTT: I would like the record to show that samples of ore and oil used in the last two experiments were furnished to counsel for the plaintiff, and that a sample of the salt solution will be furnished to them if they so desire.

MR. WILLIAMS: It has been furnished.

MR. SCOTT: And a sample of the salt solution.

DR. SADTLER resumed the stand for further

DIRECT EXAMINATION.

BY MR. SCOTT:

Q. 125. Referring again to patent 835,143, and the patent in suit, I would ask your attention to the mechanism described and illustrated for carrying out the processes and ask you to compare these mechanisms?

A. We have in the single page illustration, 835,143, shown exactly the same form of cylindrical mixing vessel with the cone mixer indicated as the form of agitating apparatus. In this patent 835,143 it will be remembered that the statement was made that the froth may be removed from the liquid by skimming or in any usual way or the frothing portion may be separated from the remainder of the pulp by causing this to flow through a spitzkasten, or the like, so that we have the skimming following the usage of the agitator as one described method or the allowing of the contents dur-

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ing agitation to flow into a spitzkasten—into spitzkastens where they come to rest and where the froth raises.

Q. 126. You have referred to the two patents containing illustrations of the same cylindrical mixer?

A. Yes, and the same form of agitating apparatus.

Q. 127. Do you notice any difference at all in the apparatus illustrated in these two patents?

A. What is that?

Q. 128. Can you point out any difference at all between the apparatus illustrated in the two patents?

A. I am not able to see that there is any difference in the illustration of the apparatus.

Q. 129. Now, doctor, if you will proceed and give us a description of the Everson patent, and explain it?

MR. WILLIAMS: Page 607, your honor, of the record which you have, 257 in the Miami record.

A. The selective activity of oil for mineral was known prior to the time of Mrs. Everson, having been indicated in the patent of Haynes, but the patent of Haynes did not present the agitation procedure in any way that could be regarded as satisfactory, and therefore I have not cited the Haynes patent as prior art, strictly speaking. It was acknowledged by Dr. Liebmann, one of the experts for the plaintiff, that Haynes disclosed the selective action of oil, and then followed the next step, the disclosure of the Everson patent and I will begin, because we have in the Everson patent therefore the knowledge already existing of the selective action of oil which is stated here, and she describes what she considers to be the action of the acid or acid

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salt solution. On page 1 of the Everson patent we find therefore: "The discovery which forms the basis of my invention is that metals and metallic substances in a comminuted state will unite with compounds of fats or oils and acids, and that such compounds will not unite with comminuted quartz or other rocky gangue. The essential feature of the method which constitutes my invention, therefore, consists in commingling with pulverized ore a fat or an oil, either animal, mineral or vegetable, or a fatty constituent or acid of an animal or vegetable fat or oil, or any constituent of a mineral oil, together with an acid, either mineral or vegetable or a soluble neutral or acid salt, for the purpose of effecting a union of the free metal or metallic portion of the ore with such admixed mineral, whereby the same may be retained in the subsequent separation of the quartz or other rock therefrom by washing or other suitable means." That is a broad statement of the invention. There is a great deal of statement then with regard to different types of ores which she has tried and which she has operated on, and an enumeration of a number of oils, mineral and animal, and vegetable, which she has also tried, and an enumeration of the acids which she has used, and that feature of her discovery which uses the oil for selective action in the presence of an acid or an acid salt. These are enumerated. And then have upon page 2 of the patent the first example of Everson, which, as I indicated in my classification of processes is an example of a bringing together by the influence of oil, of metallic particles,

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and a washing away of gangue, in that respect somewhat like the prior process or patent of Haynes, and is the essential principle involved, in the Cattermole granular agglutination from which the gangue is washed away. But if we direct our attention to the question of priority of invention in the matter of agitation, we turn to the second example of Everson which we find on page 2 of the patent also beginning, lines 75: "When petroleum or a constituent thereof is used the oil should desirably be first mixed with the ore, then water added containing a suitable amount of free acid, or a soluble neutral or acid salt, the quantity of water being ample for the washing-out operation, which is to follow, and the quantity of acid sufficient to cut the sand away from the otherwise cohering mass. In the case of petroleum or its constituents paraffine oil, one or two fluid drams of acid to one gallon of water is sufficient for this purpose. The petroleum which I have used was 30° Baume, and I have found three fluid drams of oil abundant for properly moistening two ounces of heavy ore, or in the ratio of about a barrel of oil to the ton of ore, the amount being, of course, variable with the relative bulkiness of the ore." I would desire to say here that the proportion of oil relative—weight—relative to the ore as used by Everson in the second experiment has been variously stated. I think there has been a variety or form of calculation used, probably, and I desire to say in that connection that it is perfectly easy to get an exact figure as to the percentage of oil that was used by Everson in this second example. The

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weight relative to the ore being, of course, dependent upon the gravity of the oil used. In other words, for a definite gravity of petroleum as mentioned you can figure out absolutely what the per cent of oil is by weight relative to the ore. I have figured that out, taking the data that are here given by Everson, and assuming that the oil was, as stated, 30° Be. The exact amount of oil relative by weight to the ore is 17 per cent. Under these circumstances—I have then performed—of course it must be remembered that in line 75 we have stated. "Petroleum or constituents thereof", which allows us to use petroleum in the form of a paraffine oil, as stated, or a kerosene fraction, if such are found practicable in handling with a particular ore, either can be used under the terms of this definition of Everson. Now, if we use a kerosene of about 40° Be., which is relatively a heavy kerosene, because kerosene starts with about 40° Be., and many kerosenes are much lower than that—if you start with a kerosene of a 40° Be., the per cent of oil by weight on the ore would be much less than 17.

Q. 130. About how much less?

A. I haven't figured it out on 40°. I meant to do so, but I haven't done it. I will do so and give you the figures exactly. The former calculation I probably better state, so as to make it perfectly clear that the figure is accurately determinable. We have stated there three fluid drams of oil for two ounces. That means ounces avoirdupois, of heavy ore. Now, if we multiply these figures by eight we can work the fluid

drams into fluid ounces and we can work the two ounces avoirdupois of the ore into exactly one pound av. of the ore. Therefore we now have three fluid ounces for every one pound avd. If we multiply by two thousand we would have 6,000 fluid ounces or 46.8 gallons, American gallons, to one ton of ore, a ton of 2,000 pounds. Now comes the weight of the oil of 30° Be., which has a specific gravity at the temperature ordinarily taken of 60° F., of .875. One gallon of liquid of specific gravity .875, would weigh 7.27 pounds av. That is based on the weight of a gallon of water which is unity, of course, in specific gravity. At the same temperature that would give us 7.27 pounds as the weight of a gallon of liquid of this specific gravity. Now we have stated that we have by the calculation 46.8 gallons which would therefore weigh 340 pounds. Therefore we have a weight of oil of 340 pounds, a ton of ore of 2,000 pounds, 17 per cent. And the same can, of course, be stated equally for any other quantity of oil. This is the second example then of Everson.

THE WITNESS: The patent continues:

"In the use of petroleum, or of a liquid constituent thereof, like paraffine oil, the condition of the concentrated mass is more liquid than when a vegetable oil and animal oil or a fatty constituent thereof is used, and a somewhat different means or method should be employed for removing the sand. In practice, the concentrate, after further agitation of the mass and detachment of the sand, will in this case be preferably removed by means of a constant overflow of water from

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a washing-out vessel, by which overflow the concentrate will be floated off."

First step, the agitation of the mass. Second step, the detachment of the sand. Then, following that statement:

"The devices and methods now well known in wet separation of ores will be suited to this part of the operation, bearing in mind that the sands and minerals are merely transposed, or their relative positions are reversed, because the sand is heavier than the mixture of mineral, oil and acid. A proper selection of devices for this purpose will be apparent to those skilled in the wet separation of ores."

That is all we have as to the carrying out of the operation for the removal of the concentrate. The after discussion is as to the treatment of the concentrate.

I would also note that Everson practically makes a third example on page 3 of the patent, line 17.

"It is also not essential to my invention that the acid or salt employed with a vegetable oil be added to the oil before the incorporation of the oil with the ore, as it is entirely practicable, at least in most, and possibly in all cases, to first mix such oil with the ore and thereafter add the acid, as set forth in the use of petroleum."

I said we have a first example, which is of the type of agglutination of the mineral particles and oil, and the washing out of the various minerals from the gangue. We have a second and a third example which contemplate mixing the oil and the ore before thinning

out and as the statement is made here, that it can be done, as set forth in this in the use of petroleum, we may assume that the agitation also is to be considered as a feature of the third example, as well as of the second.

Q. 131. What can you say, doctor, as to this suggestion of Mrs. Everson's that a proper selection of the devices for this purpose will be apparent to those skilled in wet separation of ores," which occurs on line 111, page 2 of the patent?

A. I consider that that refers to the use of the agitating apparatus, and to the use of the flowing off apparatus of the type that is commonly now known as the Spitzkasten type. It was at that time possible to find forms of apparatus for agitation and for the flowing off feature following the agitation, and the saving of the froth.

Q. 132. Do you know any instance of apparatus of that character being known and used prior to August, 1886, the date of this Everson patent?

A. Yes.

Q. 133. Or prior to 1885, the date of the application for it?

A. I have two patents that I will refer to first. The first of these patents is this patent No. 266,219, dated October 17th, 1882. This, of course, is in a different art and is a patent for a piece of apparatus to be used in an entirely different connection, but the only point that is important here is the question as to whether we had aerating and agitating apparatus of a kind suit-

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able to be used for the purpose to which Everson alluded. Here in this patent, which is for a churn, the following statement of its results in line 57 to 59, referring to the construction of a rotating apparatus— the object of these channels is to aerate the milk and the cream, as the machine is turned." We have here clearly enough an aeration in connection with rapid agitation shown there. In other words, we have a form of apparatus there for aerating in connection with agitation, and that is of course what is to be done if we are to produce an aerated froth.

MR. SCOTT: I offer this patent in evidence.

Patent offered in evidence marked Defendant's Exhibit No. 48.

MR. WILLIAMS: It ought to be noted on the record that this patent is given as an example as apparatus for the concentrating of ores, and we find that this device was a churn for churning cream into butter.

THE COURT: I was just thinking that our mother's egg beaters at the same date would have done the same thing.

THE WITNESS: I did not bring in everything that could be thought of; I merely said it was an aerating and agitating machine.

THE COURT: It is a form of apparatus that might perform the same purpose, so I will admit it.

Copy of patent 266,219 admitted in evidence, marked Defendant's Exhibit No. 48.

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THE WITNESS: The second apparatus is a churn also, but the possibilities are still more clearly indicated. Patent No. 306,441, F. J. Sullivan, October 14th, 1884, and I call attention there to the statement at the bottom of page 1.

"I make the parallel parts of each dasher close together, so that the air is sucked down between them by the rapid rotary motion of the circular part, and thus the entire cream is aerated. This process of distributing air through the cream is assisted by the perforations ~~R~~ D, by which I have obtained butter in two minutes, and herein is one of the great advantages of my invention."

I call attention also to the fact that the single claim of the patent specifies aeration. He says "and close together, the better to agitate and force air into the cream, substantially as set forth and described, for the purpose set forth."

This still more clearly indicates a type of aerating and agitating apparatus than the other. Those are two citations from an entirely different industry, but bearing on this question of concentration and agitation.

THE COURT: The quick concentration of milk into butter.

MR. SCOTT: I offer this second patent in evidence.

Patent 306,441 admitted in evidence without objection, marked Defendant's Exhibit No. 49.

Whereupon further hearing was adjourned until Tuesday, April 24, 10 a. m.

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Tuesday, April 24, 1917, 10:00 a. m.

SAMUEL P. SADTLER resumed the stand for further

DIRECT EXAMINATION.

BY MR. SCOTT:

Q. 134. Doctor, I think last night when the court adjourned you were giving a description of some kind of apparatus which you considered suitable for the Everson process, and in existence at the time the Everson invention was made. If you have not finished your answer, you may continue?

A. I cited two forms of apparatus, both taken from what might be called the dairy industry. I will next cite an apparatus which is already of record, namely, the extract from the treatise on the chemistry of the manufacture of soaps and candles, which was introduced by Dr. Byrne to illustrate a form of apparatus which was capable of entraining air by means of rapid agitation, (page 402 of the original Hyde record). We have an illustration there of the apparatus, and the description is the description of the class of soaps which are made by the aid of this apparatus. The heading is "Floatant Soaps." "Under this title are designated those soaps which, when in a state of paste, are batted or inflated with air, by which means its buoyancy becomes such that the soap floats in water." And after describing the material from which these soaps are made and the process of preparation, we have in the

last part of the description: "When the mass is in perfect fusion it is agitated with a twirling fan, figures 54 and 55, until it froths and foams to the top of the vessel."

I consider this apparatus as a form of apparatus which is perfectly adapted to the process of aeration in connection with agitation. If a soap in the form of paste could be inflated with air by agitation, it is obvious that the relatively thinner, floating pulp, admixed with oil, could be aerated by the same form of apparatus, by the use of agitation, which is of course capable of being done by power as well as by hand. That is the third illustration of the apparatus adapted for aeration by means of agitation, which results in the production of an aerated froth under these conditions.

The fourth illustration in the prior art goes to another industry. In the purifying of linseed oil it is necessary to carry on a purifying step in which the crude oil is to be aerated with a view of causing the separation of impurities, and I find in a book which was published in 1882 (Die trocknenden Oele, by Louis Edgar Andes, published in Braunsweig, 1882), and which I have bound and which has been in my possession in my library since 1883, a description of the apparatus known as the "cataract" machine, and photographs have been made, illustrations have been made of the apparatus, that is, a page showing the apparatus together with a title page of the book, and I will translate and put in English, therefore, the description. The description begins on the preceding page, on page 37,

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and is continued on page 38, where this figure is given, at the top of the page, where reference is made to the entraining of air. But I will read the whole description:

"The cataract machine built by the stock company for the manufacture of machines and the oil industry at Barell, in the Grand Duchy of Oldenberg appears specially adapted over all other machines of like character used for the rapid purification of oil, to displace them in use, and the same therefore deserves entrance into all varnish and lacquer establishments. Figure 6, on the following page shows a vertical section through the machine. The oil to be purified is filled into the iron cylindrical vessel up to a certain mark. On turning the rotating wheel F, the blades, F1, are moved in rapid rotation. The oil rises in consequence of the action of centrifugal force on the walls of the vessel and is then thrown by the baffles, kk, and a ring lying above and is thrown together into the middle. The oil therefore makes a circuit and during this circuit there is so intensive a mixing and so powerful an agitation, and thereby so intimate a bringing in contact with the atmospheric air as can be obtained by no other machine and can be accomplished in no other way. Therefore this machine adapts itself very well to the purifying of oil; and in addition to that can also be used for the mixing of varnish or lacquer with colors. The stock company above named builds this 'cataract machine' of from twenty to four hundred liters capacity, and such a

machine of one hundred to one hundred twenty-five liters capacity with iron vessel and rotating cover, together with the large driving wheel for hand use costs 250 marks f.o.b. Barell. Larger machines are delivered, provided for power driving by means of pulleys."

That is the description and the apparatus shows very clearly that we have there a powerful agitation, that agitation especially adapted for the entraining of air because of the construction shown, that is, the upright baffles and the rotating ring which serves also as a horizontal baffle, and, as described in the account, the oil thrown first to the side by centrifugal power is then deflected and thrown in by reason of the horizontal baffle and that action of the vertical baffle; and, as stated in the description, the oil makes a complete circuit and thereby entrains the air and is brought in most complete contact with atmospheric air. This is adapted for the carrying out of aeration by agitation and we will show the Everson process with the aid of it.

MR. WILLIAMS: You said agitation by aeration. You did not mean that; you meant aeration by agitation.

A. I meant it the other way.

MR. WILLIAMS: Just change it, if you please.

MR. SCOTT: If there is no objection to the photographic copy instead of offering the whole book I would like to offer the photographic copies of the pages.

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MR. WILLIAMS: I think you ought to include the previous page which has the greater part of the description.

MR. SCOTT: I will add that to it, the preceding page.

Q. 135. MR. WILLIAMS: This book, you say, has been in your library. Is it, so far as you know, a book of general circulation?

A. This book was got by me, together with other books on these technical industrial subjects, from a bookseller in Germany and undoubtedly it has gone into general circulation in the linseed oil industry. It it by a standard author, quite well recognized, whose works have been translated into English and are well known to everybody connected with the linseed oil and varnish industry. Andes is the name of the author. I had it within a year after it was published.

MR. WILLIAMS: In view of the obvious irrelevancy I certainly shall make no further objection.

MR. SCOTT: I have offered the photographic copies to which I take it there is no objection if I file the additional page.

The photographic copies of two pages of the book were marked defendant's Exhibit 50.

Q. 136. MR. SCOTT: On page 2 of the Everson patent, at the paragraph beginning with line 93 reference is made to the use of petroleum or of the liquid constituents thereof like paraffine oil. I think you referred to that passage yesterday, but I do not

know that you discussed it in full, the nature of the oils that are indicated by the language I have just quoted.

A. I had not finished my prior art apparatus.

Q. 137. You hadn't? I thought that was the last thing you had. Well, postpone that question, then.

I come now to the prior art apparatus to be found in the metallurgical industry, and I have a copy of Ure's Dictionary of Arts and Manufactures and Mines, published in 1860, in which we have forms of rotating blade agitators, and in which we have forms of separating boxes or spitzkasten, both of which forms of apparatus are of interest in connection with the descriptions in the Everson patent. The first of the rotating apparatus were designed for other purposes, but are entirely adaptable to the purpose which we have in mind at the moment, which is the rapid rotation with entraining of air by means of rotating blades. On page 356 is shown such a form of apparatus, figure 1419. There it is used for other purposes, and it has a cap, but with that cap removed it would be perfectly adaptable for the purpose of aeration, having blades rotating very analogous to the forms of apparatus we have in mind. This illustration is found on page 356 of Ure's dictionary, volume 3, figure 1419. The illustrations of the separating boxes known as spitzkasten are found on page 332 of the same volume.

Q. 138. Give the number of the figure please?

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A. Figures 1379 and 1380, and on page 335, figure 1385. There we have a combination of spitzkasten boxes operated together just as is shown in some of the illustrations of the patent in connection with this formation of aerated froth and collecting the same and separation from the gangue material.

Q. 139. Is that all you wish to refer to, doctor?

A. That is all I wish to refer to.

Q. 140. Then point to the court the different illustrations before we pass on, the pictures are so small you can put the book on the edge of the desk?

A. Very well. The one illustration is of the rotating blade apparatus, and the other two are of the separating boxes.

Q. 141. THE COURT: Well, this is simply for the purpose of showing that at the time of this invention—

MR. SCOTT: The patent was in 1885.

THE COURT: At the time of that patent there were such appliances?

MR. SCOTT: That is the object.

THE COURT: I have no doubt you can find such things in different branches of the art.

THE WITNESS: This is all metallurgical.

Q. 142. THE COURT: The chemistry part of it, I suppose?

A. Yes, sir.

Q. 143. MR. SCOTT: Did you state who that dictionary was published by?

A. Ure's dictionary, edited by Robert Hunt. This

is already the fifth edition of Ure's dictionary, published in 1860.

Q. 144. You have no reproduction of those views?

A. No, I haven't.

MR. SCOTT: We will have them prepared and offer them later.

MR. WILLIAMS: You did not state what purpose they were used for?

THE WITNESS: These were used for metallurgical purposes, not exactly as they would be used for the purpose referred to in the patent, but are entirely adaptable for those, by reason of their construction.

Q. 145. MR. SCOTT: Are they agitating mechanisms?

A. I am referring particularly to the agitating mechanisms.

Q. 146. What are they described there for, agitation or for what purpose?

A. This was employed for the excluding of the fine refuse and slime ore by rapid rotation, as it is stated.

Q. 147. What are the spitz boxes that you referred to used for?

A. They were used for what might be called classifying the ore according to the different grades of fineness.

Q. 148. Does that complete your discussion of the apparatus?

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A. No. I have yet one more

P. 2859, L. 3, insert " and refer to the great chemist of the sixteenth century " after " Century "

...gricola's work on the Metallurgical Art, first published in 1556, 361 years ago, and I have one of the illustrations of this work of Agricola now for the first time, I believe, in complete English form of translation, and this illustration shows me very clearly the exact form of rotating paddle adapted for use for agitation with entraining of air—exactly the form that is used in a number of pieces of apparatus which we are using at the present time, and the apparatus is described here—here are the upright axles, and the large rotating one, and the paddles and this was primarily of the year 1556, and appears in the English translation of Agricola's Metallurgical Art, which has been issued by Herbert Clark Hoover in 1912.

MR. WILLIAMS: Where is the original book?

THE WITNESS: The original book is on the table.

Q. 149. MR. WILLIAMS: Do you remember the page?

A. 299. 299 is the page.

Q. 150. When was this book published?

A. It is dated on the front page.

MR. SCOTT: 1912. We are quite unable to prove the fact that this book was originally printed in 1556.

MR. WILLIAMS: You could call Mr. Hoover, couldn't you?

MR. SCOTT: Mr. Hoover could not prove it either. It is a book that exists only in museums and on collector's shelves; it being a well known fact we thought possibly you would stipulate the date of Agricola.

MR. WILLIAMS: It is quite evident, your honor, that it is not capable of proof and there is no proof as it stands, as to the publication prior to our invention, and I have not read the article. It is a very interesting picture. I am not prepared to say whether we will let it in without objection or not, but we will give that matter consideration.

THE COURT: I remember in the Hyde case you went back to Herodotus.

MR. WILLIAMS: Yes, sir. (Laughter.)

MR. SCOTT: If I remember correctly, you failed to prove the date of Herodotus's birth also.

MR. WILLIAMS: I will look at the book. I will move to strike it out after I read it if I think necessary.

MR. SCOTT: You can take the book home with you.

THE COURT: Do you offer this exhibit?

MR. SCOTT: Yes, sir, I offer the photograph of the illustration from the work of Agricola.

THE COURT: It will be admitted tentatively.

Photograph from work of Agricola admitted in evidence and marked DEFENDANT'S EXHIBIT No. 51.

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THE WITNESS: That completes my statement on that subject.

Q. 151. Referring to this Everson patent, line 93, page 2, will you explain a little more fully the character of the oils that are indicated by the expression "petroleum or a liquid constituent thereof, like paraffine oil."

A. We have that same expression—we have that form of expression in two places; in line 75 also: "When petroleum or a constituent thereof is used," indicating that Mrs. Everson contemplated the use of any petroleum fraction that would be found adapted for the purpose. We have it also in line 93: "In the use of petroleum or liquid constituent thereof," and she takes the case of paraffine oil as one of those liquid constituents of petroleum. I gave in the discussion of this patent yesterday the calculation that if you take the petroleum which she used, and herein referred to specifically as used in the particular experiment mentioned, an oil of 30° Be., and as stated here there was 17 per cent by weight of the ore taken. I also said that if you took a lighter fraction or a constituent of petroleum of lighter gravity, the weight would reckon out as less than that; for instance, if you took 40° Be., which is about the heaviest gravity of the very heaviest kerosene, which is frequently called paraffin, and in England is called paraffin oil —the calculation comes out differently. The actual specific gravity corresponding with the figure 40° Be. is .8235, and calculating the weight of a gallon

of oil or liquid of that gravity, and calculating from that the percentage on to a ton of ore, you get 15.9 per cent instead of 17. Of course there are kerosenes which run from 40 Be. up to 54 and 55 and more. I can readily substantiate that by reference to standard works on petroleum recently issued of the highest authority, as to what are the gravities of commercial kerosene oil as made from different types of crude oil; it would range from 40 to 58 gravity.

MR. WILLIAMS: I move to strike that out because we are not concerned with what kind of a kerosene are made today, but only with the kinds of kerosene that were made in 1886.

THE COURT: Well, it may be illustrative. Of course the court knows and we all know that there is a time in this case to which the evidence must relate, but it may be illustrative. He has a right to discuss the art of today and contrast it with what it was then, without it perhaps being so very material to this issue. The motion will be denied. If it is not entitled to any consideration, the court will give it none in making up its decision.

Plaintiff excepted.

Q. 152. MR. SCOTT: Doctor, you may explain the expression?

A. I will say that I know of my own knowledge what kerosene was in 1885.

Q. 153. Then you may state, if you will, what kerosene was in 1885, and other petroleum constituents as referred to here?

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A. Kerosene in 1885 as I was acquainted with it—it practically all was made from Pennsylvania oil—it ranged considerably above 50° Be. in gravity; distinctly above.

Q. 154. Did you explain this Baume scale of liquids lighter than water, such as these oils that you are speaking of, as to the numbers indicating the Baume degree increases, the substance is heavier or lighter?

A. As the numbers increase the substance is lighter.

Q. 155. That is, 50° oil is lighter than 40° oil?

A. Yes. The ordinary gasolene which is sold today is ordinarily 62° Be.; a very light gasoline may be up to 80° Be., and the extremely volatile material which is now being made on a large scale from casing head gas by pressure and chilling runs up to 90° Be., which is very, very light. Then we go down to the range of 50° Be. in kerosene oils, or a little over, and we get down below that to 30° Be. and lower than that for lubricating oils.

Q. 156. Was there any difference in the amount of volatile constituent in kerosene in 1885 and today?

A. No, not that I am aware of. The same range is found in crude oils now as it was then.

Q. 157. I meant in the manufacture of kerosene as a finished product; I think you call it flash point—was its flash point higher or lower than it is now?

A. The grading of kerosene by means of a flash point was in current use at that time, and they were carefully brought within a space range by the exclu-

sion of their volatile portions, so as to conform to the legal fire test or flash test.

Q. 158. I would like to refer you, doctor, to two newspaper articles that are in evidence in the Hyde case; they have become known in this suit as the Fryer Hill publication and the Criley-Everson publication, and if you will explain to the court the nature of the disclosure of the process?

A. The Fryer Hill publication appeared in October, 1889 in the Daily Herald Democrat of Leadville, Colorado, and is headed: "An Important Invention." After referring to the particular ores which are important to be treated, we find the following statements in regard to this process or invention:

"The first unimportant means of testing the new system having proven so incontestably the correctness of the theory, other larger and more capable means have been employed. The whole system of concentration appears to be based upon the recognized affinity of the lighter forms of sulphuret in silver ores for oil. Petroleum is the oil now being used for the purpose by the parties having these experiments in charge, and appears from its density to possess the requisite adhesiveness to effect the result desired. The ore is first crushed and rolled to such a degree of fineness as to enable it to pass through a 40 mesh screen, and while dry is thoroughly mixed with oil, after which it is placed in a circular tank or receiver, through the center of which runs a rotating hollow tube. To the

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bottom of this tube is attached on two opposite sides a couple of fans, the lower edges of which are unevenly cut, in order to send in the revolution the lighter particles of the ore and the oil mixed to the outer sides of the drum or cylinder. This hollow rotating tube—"

THE COURT: This is already in the record?

MR. SCOTT: This is already in the record.

THE COURT: I don't see any necessity of the doctor reading it; it is in there. Any comment he wants to make—

THE WITNESS: I will then proceed with the comments.

THE COURT: It is already in the record; we have it before us.

A. (Continuing): I would call particular attention to that portion of the account which begins: "The action of the revolving tube" which is the tenth line. "the action of the revolving tube, the fans and the injected acidulated steam causes the lighter portions of the mineral bearing oil to float to a point just above the center of the receiver, where there are suspended two semicircular doors which, when the oil has passed above them, laden with its precious freight, are raised and the superfluous water allowed to drain through slight perforations in the bottom of the semi-circular doors, after which the mineral-laden oil is carefully removed to settling tanks" and so on—That is not material. Now I desire to comment on it in this way. We have described there a form of apparatus involv-

ing rapid agitation and involving at the same time aeration. The conditions are to be recalled, that is we have this revolving tube with fans and injected acidulated steam. Under this condition there is no doubt but what we have the conditions for the aeration of the mixture and the production of the froth. If the froth rises and the construction of the apparatus—I should say, before going on farther the semi-circular doors as first in position act as baffles. They hang vertically; they interrupt the rotary motion of the flowing pulp and undoubtedly act in the entraining of air and in that way we get the result which is noted. When the froth has formed, which is of course mineral-bearing froth under this condition, these doors are to be raised. Now, I want to make some comment on that latter portion, then, of the operation. The language describing the results of the operation of the Everson process, as here given in the Fryer Hill publication, and the action of the revolving tube, the fans and injected acidulated steam, it is stated cause "the lighter portion of the mineral-charged oil to float," and then, as stated before, that is taken off. Now, in the first place, there are no lighter portions of a layer of petroleum oil, such oil as is used here, if we consider the question of oil only, as petroleum oils do not stratify in layers of unequal gravity. But if the oil were thoroughly aerated, as is indicated by the reference just preceding, by the action of a revolving tube, the fans and the injected acidulated steam, then the aerated

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layer, or air froth, would be lighter than either any excess oil or water, and would float, as stated in the account of the results obtained. I desire to emphasize that fact, that it is impossible to consider that expression "the lighter portion of the mineral-charged oil," to refer to an oil layer, because oil don't stratify. In the second place, the use of the word "float" here used is understood when one considers the production of an aerated air and oil froth, and has no proper meaning if we simply suppose that an oil layer of the compact Elmore type is to be understood as the layer which is taken off. The word "float" indicates that we have a mass of aerated, mineralized material, or "bubbles," in other words, coated.

In the third place, the reference to this lighter portion which floats to the top as the "mineral-laden" shows it to have been an air froth, mineral-laden, because of the selective action of the oil and the agitation used. An un-aerated layer of compact oil, like that used in the Elmore process, would carry the mineral particles in the lower layers rather than in the upper layers, as has been noted by various ones of the plaintiff's expert witnesses as well as by counsel in discussing the Elmore layer, and overloading of that Elmore layer with mineral particles.

In the fourth place, drainage away from a froth "through the slight perforations in the bottoms of these semi-circular doors" is easy and practical, whereas drainage of the water from a compact oil layer by the means indicated would be very difficult to effect, as

the oil would pass out largely with the water through the perforations in the doors. And in the fifth place, mineral particles from the lower strata of the assumed compact oil layer would speedily clog the "slight perforations" in the semi-circular doors; or, if they passed through would make it impossible to get clean tailings. As the ore is stated to have been a silicious one, the tailings would have been very light colored and the contamination would at once be apparent. I conclude, therefore, if, as stated in this Fryer Hill publication, the "lighter portions of the mineral-charged oil" float off, it is because a froth has formed which becomes "mineral-charged." That seems to me to be the clear interpretation of these words.

Q. 159. You have an apparatus of the character described here, doctor?

A. That apparatus has been constructed and was shown in the Miami case, an apparatus constructed as nearly as might be according to the description given in the Fryer Hill publication, and it will be shown here as illustrative of the Everson process.

Q. 160. It will be shown here and operated as soon as it is ready?

A. Yes.

Q. 161. Have you considered this Criley and Everson publication appearing on page 740 of the Hyde record?

A. In the Criley and Everson publication, in which we have of course the direct association with the name

1129

3081

No. ....

United States Circuit Court of Appeals

For the Ninth Circuit

2

MINERALS SEPARATION, LTD., ET AL,

Appellees,

vs.

BUTTE & SUPERIOR MINING COMPANY,

Appellant.

Transcript of Record

Volume 6

(Pages 2869 to 3540, Inclusive)

UPON APPEAL FROM THE UNITED STATES DISTRICT COURT FOR THE DISTRICT OF MONTANA

McKee Ptg. Co., Butte, Mont.

Samuel P. Sadtler

"Everson," we have no forms of apparatus described. We have several very important statements of conditions. The ore was crushed and passed through a 60 mesh screen dry and thoroughly mixed with black, thick oil, presumably a petroleum product. To water heated to near boiling was added enough sulphuric acid to give it a tartish taste. This acid and water was then mixed with the mass of oil and ore. Now, there is entire absence of any account of the form of apparatus or how the agitation was carried out, but the result alone is stated. A thick scum of sulphurets rose to the surface and was skimmed off, leaving the hitherto black ore as white as snow, in fact pure silica. These are the vital elements in this statement.

Q. 162. Do the results stated in the sentence you have just quoted beginning "a thick scum"—Does that convey any information regarding the operating process?

A. That shows I think, clearly that it was the same process as would have been carried out with the same apparatus which is figured in this other publication, and the results would have been the same as there obtained. The scum is the froth in this case.

Q. 163. If you will refer once more to the Everson patent, page 607 of defendant's record in the Hyde case, on page 1 of the patent, beginning at line 17, extending to line 20, the same page, beginning at line 81 extending down to about 86, the patentee makes statements regarding the character of oils adapted for her process. Will you state how extensive a category of

oily substances is set forth in the language used in these passages?

A. The list is a very comprehensive one. In line 17 we have the expression "a fat or an oil, either animal, mineral or vegetable, or a fatty constituent or acid or animal, vegetable mineral or oil or any constitunent of a mineral oil." These terms cover all of the animal and vegetable oils and their constituents like oleic acid, which is a fatty acid derived from an animal and vegetable oil. And that covers all of the petroleum fractions because "any component of a mineral oil" is there mentioned. And the same thing is used with a little more expressive statement of particular oils, in line 80:

"I used petroleum and one of its several components, viz., paraffine oil." But the whole range of petroleum constituents can be covered by that earlier language, also tallow in melted form, lard, lard oil, red oil, meaning thereby impure oleic oil, cottonseed oil, castor oil, sperm oil, linseed oil and some combination of these with each other. That gives us a range of fatty oils or what might be called fixed oils, of both animal and vegetable origin. It does not specify an essential oil or one of the terpene type oil, but that is covered under the broad statement "fat or oil, either animal, mineral or vegetable."

MR. SCOTT: I think now, as the continuity of our case has been broken a little through necessity, I will discontinue the examination of Dr. Sadtler for the time being and put on another witness in order to get the things before the court that the doctor will want to

refer to before he finishes, and opposing counsel may either cross examine now or later as they choose.

MR. WILLIAMS: I think it will be better to postpone the cross examination until the completion of the deposition, as matters stand. Of course there may be some incidents that require it.

THE COURT: This promises to be a long case and you ought to have your witnesses in order and know what they are going to testify to and have everything ready.

MR. SCOTT: The evidence is all ready. It is simply the mechanical work that is necessary.

WITNESS TEMPORARILY EXCUSED.

JOHN WARNE PHILLIPS, a witness called on behalf of the defendant, being first duly sworn testified as follows:

DIRECT EXAMINATION,

BY MR. SCOTT:

Q. 1. State your full name.

A. John Warne Phillips.

Q. 2. Will you kindly state your occupation?

A. I am connected with Mariner & Hoskins, chemists and engineers of Chicago, at the present time, and represent them here now at this case.

Q. 3. And what is the nature of your duties or profession?

A. I graduated from Princeton and spent two years there as a post graduate and was instructor there for three years and then I accepted a position of professor of chemistry and physics in the University of Nevada and taught there for ten years and then I carried on metallurgical operations in plants of my own, and for several years I was manager of the Overland Mining Company, of Gold Hill, Nevada, and for four years I have been connected with the engineering firm in Chicago of Mariner & Hoskins, as chemical engineer.

Q. 4. Have you made any investigations of the character of froths produced in the flotation process?

A. I have.

Q. 5. Just briefly, without going into details at present, just state the nature of the operations you carried out.

A. I used several—I have used three varieties of oils, practically on the same charge, on a laboratory scale. The charge used was 60 grams of ore, 250 c. c. of water and copper sulphate in the proportion of one-fifth of a pound of copper per ton of ore, and sulphuric acid in the proportion of 8 lbs. of 60° Be. sulphuric acid per ton of ore. I added the pulp of course first to the vessel and then the water and then the copper sulphate and then the acid and agitated for one-half minute so as to thoroughly stir the pulp with the solution and then I add the oil and agitate it for eight minutes, and most of the tests, most all of the tests were carried on in that method, that procedure.

John Warne Phillips.

Q. 6. What was the ore that you used?

A. The ore used was a Butte & Superior ore, I think mill heads, lot No. 2. It assayed 16% of zinc, if I remember rightly, about—Its fineness was 6% on an 80 mesh and about 60% through a 200 mesh.

Q. 7. And what kind of an apparatus did you use for these experiments?

A. We used an ordinary soda fountain or bar mixer, electric mixer, and for the vessel we used a rectangular-shaped vessel, I think used for a battery jar, about 5½ inches high, 2 inches wide and about 2½ long, that is, a rectangular shape.

Q. 8. And you made photographs, did you, of these froths?

A. Made photographs.

Q. 9. Will you describe the character of the different photographs you made, the views?

A. We made three series of photographs. The first was taken, a photograph of the froth through the side of the vessel and a magnification of 15 diameters, or that would be 225 times, magnified 225 times. And all photographs of that cahracter are labeled No. 1, or series 1.

Now, series 2, photographs were made through the sides of the vessels in the same way, but a magnification of five diameters or 25 times; and photographs No. 3 series, 3 was made of the top of the froth by using a prism and taking the top view of the froth. They were not magnified, supposed to be normal. Now, these magnifications are not absolute, but very near.

John Warne Phillips.

We determined the magnification by taking a photograph of a scale in the place where the froth or object was, and measuring the image of this scale, on the ground plate of the camera, and taking the ratio between those two. That is the method we obtained of magnification, particularly five magnification and fifteen magnification.

Q. 10. Were you present throughout those operations of making these different froths, and supervising it or performing it?

A. Yes, at all times.

Q. 11. And the same is true of the making of the photographs?

A. The making of the photographs; I was present when the exposures were made and instantly after the exposure I put a number on the negative before it was printed.

Q. 12. I will show you some of these photographs and ask you if you can identify them. The distinguishing numbers are different in each case?

A. Yes.

Q. 13. So if you identify them by number it will be definite, will it?

A. Yes.

Q. 14. Now, will you kindly state what this photograph bearing the number 16-3 is?

A. That is a top view of froth containing one-tenth of 1% oil, mixture No. 3.

Q. 15. And will you state what that oil mixture is?

A. What it comprises?

John Warne Phillips.

Q. 16. What oils and what proportions?

A. I can't remember that.

Q. 17. Refer to your notes.

A. The oil mixture contained 70% crude fuel oil, 18% yaryan pine oil and 12% refined kerosene.

Q. 18. And the proportion is one-tenth of 1%?

A. Yes.

Q. 19. Now I hand you another one which is marked with the number 17-3 and ask you to identify that and state what that represents.

A. 17-3 is the same but contains three-tenths of one per cent. of oil mixture.

Q. 20. Of the same oil mixture?

A. Oil mixture No. 3.

Q. 21. Now I hand you another photograph which bears the designation 1-3.

A. That is a photograph, top view, of froth containing 4/10 of 1% oil mixture.

Q. 22. The same oil mixture?

A. No, not the same oil mixture. The oil mixture of this other varies just slightly in containing 17% yaryan pine oil and 13% kerosene instead of 18% and 12%.

Q. 23. Now I hand you a photograph marked 2-3.

A. That is a top view of the same character of charge but containing one-half of 1% of oil mixture.

Q. 24. What oil mixture was that, the same as number—

A. The same as No. 1-3.

John Warne Phillips.

Q. 25. Now I hand you another photograph marked 3-3.

A. That is a top view of froth containing six-tenths of 1% oil mixture.

Q. 26. The same oil mixture?

A. The same oil mixture as No. 1, 2 and 3.

Q. 27. I hand you another photograph designated 4-3.

A. That is the same oil mixture. The same view, but containing 1% of oil mixture.

Q. 28. As one oil mixture?

A. As one oil mixture.

Q. 29. The same oil mixture as 1, 2 and 3?

A. Yes, the same charge.

Q. 30. Now I hand you another photograph bearing designation 8-3.

A. That is the same as—top view of froth and containing 1¼% oil mixture, same oil mixture.

Q. 31. Photograph bearing designation 5-3.

A. That is a top view of froth containing 1½% of the same oil mixture.

MR. SCOTT: I think I will offer the set right now, to avoid confusion. I offer in evidence the photographs just identified by the witness and ask that each be marked as a separate exhibit in the following order: Photographs 16-3, 17-3, 1-3, 2-3, 3-3, 4-3, 8-3, 5-3.

The photographs were admitted in evidence and marked DEFENDANT'S EXHIBITS 52 to 59 inclusive.

John Warne Phillips.

Q. 32. MR. SCOTT: Mr. Phillips I hand you a photograph marked 16-2 and ask you to identify and describe what it represents.

A. That is a side view of the froth taken from the sides of the vessel containing one-tenth of 1% of oil mixture No. 3 and a magnification of five diameters or 25 times.

Q. 33. You say oil mixture No. 3; is that the one you described before?

A. The first, yes.'

Q. 34. That is the first oil mixture you described before?

A. Yes.

Q. 35. This picture was taken how, did you say; through the side?

A. Through the side of the vessel.

Q. 36. Of the glass jar in which it was made?

A. Yes. And the dark line below shows water below the froth, this dark spot?

Q. 37. And how high that line of froth extends on the picture?

A. The froth extends along this line here, right along here, and all of this froth, all this frosting above is the creep on the side of the vessel.

Q. 38. Will you please make a mark on the photograph, a letter or a number or something to show the upper boundary of the froth?

A. This froth was only a quarter of an inch in depth, consequently the froth in the picture should not

be over an inch and a quarter in depth to be five diameters.

MR. SCOTT: The witness has made a mark on the photograph and written the word "top" to indicate the upper surface or edge of the froth.

Q. 39. Now, what is that appearance above the top of the froth that is indicated in the upper part of the photograph?

A. That is the creeping of the oil and ore on the inside of the vessel, up on the inside of the vessel, during agitation. When it settles down it comes down and leaves this frosting on the inside of the vessel.

Q. 40. It is merely the dirty side of the vessel?

A. Dirty glass inside.

MR. SCOTT: I offer this photograph marked 16-2.

Said photograph was admitted in evidence and marked DEFENDANT'S EXHIBIT No. 60.

Q. 41. MR. SCOTT: I hand you another photograph marked 17-2 and ask you to state what that represents.

A. This represents the same view and the same oil mixture but contains three-tenths of 1% of oil.

Q. 42. Of the same mixture as that of No. 16-2?

A. Yes, of No. 16-2.

Q. 43. Will you indicate on this photograph also the top of the froth if it shows there or does it extend away to the top of the picture?

A. No, it doesn't extend away to the top of the picture.

John Warne Phillips.

Q. 44. Is it possible to tell just where the froth does leave off and where the dirty side of the jar begins?

A. It is difficult in this case. I think the froth is about along on this line, right in through there; this represents this top of the froth. The average depth of the froth was 2½—or one-half an inch, I should say. One-half inch magnified then, five times would make it 2½ inches deep, so these marks through there, the openings, to my mind would indicate the top of the froth.

Q. 45. Just make a mark on that similar to the other one.

(Witness marks the photograph.)

MR. SCOTT: I offer this photograph marked 17-2.

Said photograph was admitted in evidence marked DEFENDANT'S EXHIBIT 61.

Q. 46. I hand you photograph marked 1-2 and ask you to identify it.

A. This is the same view magnified five diameters, 25 times, but contains four-tenths of 1% oil mixture, the second oil mixture.

Q. 47. Can you indicate on this photograph about the position of the upper surface of the froth?

A. I think this is along there near the top of the picture.

Q. 48. This one you named the amount of oil, didn't you, as four-tenths of 1% of the second oil mixture?

John Warne Phillips.

A. Yes, four-tenths of a per cent.

MR. SCOTT: I offer this photograph bearing No. 1-2.

Said photograph was admitted in evidence and marked DEFENDANT'S EXHIBIT No. 62.

Q. 49. MR. SCOTT: I hand you another photograph bearing No. 2-2 and ask you to identify it and describe it.

A. This is the same view taken through the side of the vessel magnified 25 times and contains one-half of 1% of oil mixture.

Q. 50. Can you identify the position of the top of the froth?

A. I have.

Q. 51. By an ink mark and the word "Top"?

A. Yes.

MR. SCOTT: I offer this photograph marked 2-2.

Said photograph was admitted in evidence and marked DEFENDANT'S EXHIBIT 63.

Q. 52. I hand you a photograph marked 3-2?

A. This was taken through the side of the vessel, magnified 25 times, and contains six-tenths of one per cent oil mixture. The froth extends nearly to the top of the picture.

MR. SCOTT: I offer this photograph in evidence.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT 64.

John Warne Phillips.

Q. 53. I will ask you to describe this photograph, marked 4-2?

A. This was taken through the side of the vessel, magnified 25 times, and contains one per cent of the oil mixture.

Q. 54. The froth extends to the mark you have just put on the picture, does it?

A. Yes.

MR. SCOTT: I offer the photograph marked 4-2 in evidence.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT 65.

Q. 55. I hand you photograph marked 8-2 and ask you to describe it?

A. This is taken through the side of the vessel, magnified 25 times and contains one and a quarter per cent oil mixture.

Q. 56. When you say contains one and a quarter per cent, you mean, do you not, that the froth was made by using one and one quarter per cent of oil relative to the weight of the ore?

A. Yes, sir.

Q. 57. You don't mean that the froth itself contains one and a quarter per cent?

A. No; the charge was made up by using one and a quarter per cent of oil to the amount of ore used.

Q. 58. Does the froth extend to the point you have designated on this photograph?

A. To the top, yes, sir.

MR. SCOTT: I offer the photograph 8-2 in evidence.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT No. 66.

Q. 59. I hand you a photograph marked 5-2 and ask you to describe it?

A. This is taken through the side of the vessel, magnified 25 times, and the charge was made up to contain one and a half per cent of the oil mixture.

Q. 60. Of the same mixture?

A. Of the same mixture as the preceding.

MR. SCOTT: I offer this photograph marked 5-2 in evidence.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT No. 67.

Q. 61. Now, Mr. Phillips, there was a little change in the oil mixture, as I remember it, the photographs numbered 16 and 17—

A. Were made from the oil mixture No. 3.

Q. 62. And the photographs 1, 2, 3, 4, 8 and 5—

A. Were made up from another oil mixture which was not numbered, just labeled oil mixture, and that oil mixture contains 70 per cent of crude fuel oil, 17 per cent of Yaryan pine oil and 13 per cent of refined kerosene.

Q. 63. And you described the mixture that was used before for 16 and 17?

John Warne Phillips.

A. I did, yes, sir, mixture No. 3.

Q. 64. I hand you a photograph marked 16-1, and ask you to state what it repersents?

A. This is a photograph of the froth taken through the side of the vessel, magnified 225 times.

Q. 65. That would be 25 diameters?

A. Fifteen diameters; and it contains one-tenth of one per cent of oil mixture No. 3. All pictures marked 16—16-1, 16-2, and 16-2—were taken from the same experiment or the same froth.

Q. 66. And the numbers 1, 2 and 3 indicate?

A. Indicate the series of the picture and the first number, 16, represents the test.

Q. 67. And all pictures numbered 1 are what kind of views?

A. Taken through the side of the vessel, magnified 225 times. Pictures marked 2 are taken through the side of the vessel, magnified 25 times, and all pictures numbered 3 represent the top view of the vessel of natural size.

Q. 68. This 1, 2 and 3 that you just referred to is the second of the two figures which appears on the photograph?

A. The second numerals.

Q. 69. And the first numeral appearing on the photograph designates the particular test?

A. The particular test and the particular charge.

Q. 70. And wherever the same number is the same on two or three photographs, they are photographs of the same test?

A. Of the same test, the same froth.

Q. 71. You just gave the proportion of the oil?

A. Yes, one tenth.

Q. 72. Does that froth extend clear to the top of the picture I hold in my hand now?

A. I should say nearly; it is perhaps to there.

Q. 73. Will you explain to the court, by reference to these experiments which were performed yesterday —these illustrations of the Cailfornia Journal which are now standing here—explain to the court just what the indefiniteness is in telling where the froth leaves off at the top?

A. Here is an example here; taking the froth here —that would occur in the picture, and still the top of the froth would be down somewhere here, and we have to take really the measurement of the thickness of the froth.

THE COURT: That was made by the court tipping it up a while ago. You mean the upper part?

A. The upper part, yes, sir.

MR. SCOTT: I offer this photograph marked 16-1 in evidence.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT No. 68.

Q. 74. I hand you another photograph marked 17-1. Please describe that.

A. 17-1 is a side view, taken through the vessel, magnified 225 times. The charge was made up of three-

John Warne Phillips.

tenths of one per cent oil mixture No. 3 and the picture does not extend to the top of the froth.

MR. SCOTT: I offer this photograph marked 17-1 in evidence.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT No. 69.

Q. 75. I hand you another photograph marked 1-1, and ask you to describe it.

A. This is taken through the side of the vessel, magnified 225 times. The charge is made up of four-tenths of one per cent oil mixture. The picture does not extend to the top of the froth.

MR. SCOTT: I offer this photograph marked 1-1 in evidence.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT No. 70.

Q. 76. I hand you a photograph marked 2-1 and ask you to describe it?

A. Taken through the side of the vessel, magnified 225 times. The charge is made up of one-half of one per cent oil mixture and the photograph does not extend to the top of the froth.

MR. SCOTT: I offer in evidence photograph marked 2-1.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT No. 71.

Q. 77. I hand you a photograph marked 3-1 and ask you to describe it?

A. Taken through the side of the vessel, magnified 225 times. The charge is made up of six-tenths of one per cent oil mixture, and the photograph does not extend to the top of the froth.

MR. SCOTT: I offer in evidence photograph 3-1.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT No. 72.

Q. 78. I hand you a photograph marked 4-1.

A. Taken through the side of the vessel, magnified 225 times. The charge is made up of one per cent oil mixture. The photograph does not extend to the top of the froth.

MR. SCOTT: I offer in evidence photograph 4-1.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT 73.

Q. 79. I hand you a photograph marked 8-1 and ask you to describe it?

A. Taken through the side of the vessel, magnified 225 times. The charge is made up of one and a quarter per cent oil mixture. The photograph does not extend to the top of the froth.

MR. SCOTT: I offer photograph 8-1 in evidence.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT 74.

John Warne Phillips.

Q. 80. I hand you a photograph marked 5-1 and ask you to describe it?

A. This was taken through the side of the vessel, magnified 225 times. The charge is made up of one and a half per cent oil mixture. The photograph does not extend to the top of the froth.

MR. SCOTT: I offer in evidence photograph marked 5-1.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT 75.

Q. 81. I hand you a photograph marked 21-3 and ask you to describe what it represents?

A. 21-3 is a top view of the froth. The charge is made up of one-tenth of one per cent of oil mixture No. 3.

Q. 82. The photographs which I hold in my hand were they of the same tests?

A. No, no—I beg your pardon; instead of oil mixture, this is pine tar oil. The label of the oil it is made of is marked wood tar oil. One-tenth of one per cent wood tar oil.

Q. 83. You have stated that this was a top view?

A. Yes, a top view.

Q. 84. And these top views are substantially of the same size as the original?

A. Yes, the natural size.

MR. SCOTT: I offer this photograph 21-3 in evidence.

John Warne Phillips.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT 76.

Q. 85. What can you say as to the character of the float in that photograph 21-3 which is now designated exhibit 76?

A. It was a very watery froth, and the bubbles were not persistent, and it was very tender and easily broken down, and disintegrated in a short time.

Q. 86. Did it seem to carry much mineral or little mineral?

A. It seemed to carry quite a great deal of mineral, it was heavily loaded.

Q. 87. Was it voluminous or heavy or thin?

A. No, it was very thin, only a quarter of an inch in depth.

Q. 88. I hand you a photograph marked 22-3, and ask you to describe what is there represented.

A. This is a top view of the froth, the charge made up of three-tenths of one per cent wood tar oil.

Q. 89. What can you say as to the character of a froth that was formed in that instance?

A. The froth was very easily broken down; the bubbles on top disappeared, but the froth was more voluminous than in 21-3.

MR. SCOTT: I offer this photograph 22-3 in evidence.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT No. 77.

John Warne Phillips.

Q. 90. I hand you photograph marked 9-3 and ask you what that represents?

A. This is a top view of the froth. The charge was made up to compose four-tenths of one per cent pine tar oil. Both of those oils were purported to be the same, but the vessel in which one was was labeled wood tar oil and the other pine tar oil.

Q. 91. Who was it that stated they were the same?

A. Mr. Dosenbach.

Q. 92. What can you say as to the froth that was formed in the instance of this photograph 9-3?

A. It was very permanent and persistent.

MR. SCOTT: I offer photograph 9-3 in evidence.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT No. 78.

Q. 93. This last one, 9-3, was made with four-tenths of one per cent oil?

A. Yes, sir.

Q. 94. The two of the previous ones of the series, 21-3 and 22-3 were made with respectively one-tenth and three-tenths?

A. Yes, sir.

Q. 95. I hand you photograph marked 10-3 and ask you to describe what is there represented?

A. The top view of the froth. The charge was made up to compose five-tenths of one per cent of pine tar oil.

MR. SCOTT: I offer this photograph 10-3.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT No. 79.

Q. 96. I hand you photograph marked 11-3 and ask you to describe what it represents?

A. It represents the top view of the froth, the charge made up to compose six-tenths of one per cent of pine tar oil.

MR. SCOTT: I offer in evidence photograph marked 11-3.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT No. 80.

Q. 97. I hand you photograph marked 12-3 and ask you to describe what is represented?

A. Top view of froth, the charge made up to compose one per cent of pine tar oil.

MR. SCOTT: I offer in evidence photograph 12-3.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT No. 81.

Q. 98. I hand you photograph marked 13-3 and ask you to describe it?

A. This represents the top view of froth, the charge made up to compose one and a half per cent of pine tar oil.

MR. SCOTT: I offer in evidence 13-3.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT No. 82.

John Warne Phillips.

Q. 99. I hand you photograph marked 14-3 and ask you to describe it?

A. Top view of froth; charge made up to compose two per cent pine tar oil.

MR. SCOTT: I offer in evidence pohtograph 14-3.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT No. 83.

Q. 100. I hand you photograph marked 21-2 and ask you to state what it represents?

A. This represents the side view of the froth taken through the vessel, magnified 25 times, the charge made up to contain one-tenth of one per cent wood tar oil.

Q. 101. That is this photograph and the following ones of the series represent the same tests that were pictured in the top views which you have just described?

A. Yes, sir. The side view of 21 is the same as the top view of 21—the same froth.

Q. 102. It corresponds to 21, in the top views?

A. Yes, sir.

Q. 103. Will you indicate about where the top of that froth comes?

A. About there.

MR. SCOTT: I offer photograph 21-2 in evidence.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT No. 84.

Q. 104. I hand you photograph 22-2 and ask you what it represents?

John Warne Phillips.

A. Side view of froth taken through the vessel, magnified 25 times, and the charge made up to compose three-tenths of one per cent of wood tar oil.

Q. 105. You have indicated the top of the froth on this picture?

A. I have, yes, sir.

MR. SCOTT: I offer photograph 22-2 in evidence.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT No. 85.

Q. 106. Now, 21-2 and 22-2 that you have just described are side views of the same froth that was represented in the two top views that you described as being thin and tender?

A. They are.

Q. 107. I hand you photograph 9-2 and ask you to describe what is represented?

A. This is a side view of the froth, magnified 25 times, the charge composed of four-tenths of one per cent pine tar oil.

Q. 108. You have indicated the top of the froth?

A. I have.

MR. SCOTT: I offer photograph 9-2 in evidence.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT No. 86.

Q. 109. I hand you photograph 10-2 and ask you to describe it?

A. Side view of froth taken through the vessel, mag-

John Warne Phillips.

nified 25 times and the charge is made up to contain one-half of one per cent, pine tar oil.

Q. 110. The top of the froth is about where on that picture?

A. About through here. That bubble extended up on the side of the vessel.

MR. SCOTT: I offer the photograph 10-2 in evidence.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT No. 87.

Q. 111. I hand you photograph 11-2 and ask you to describe it?

A. Side view of froth taken through the side of the vessel, magnified 25 times and the charge made up to contain six-tenths of one per cent pine tar oil.

Q. 112. You have indicated the top of the froth, have you?

A. Yes, as near as I can.

MR. SCOTT: I offer 11-2 photograph in evidence.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT No. 88.

Q. 113. I hand you photograph marked 12-2 and ask you to describe it?

A. Froth taken through the side of the vessel, magnified 25 times, the charge made up to compose one per cent of pine tar oil.

Q. 114. The top of the froth appears about where as near as you can estimate?

A. About there.

MR. SCOTT: I offer photograph 12-2 in evidence.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT No. 89.

Q. 115. I hand you photograph 13-2 and ask you to describe it?

A. Photograph of the froth taken through the side of the vessel, magnified 25 times, the charge made up to contain one and half per cent pine tar oil.

Q. 116. You have indicated the top of the froth?

A. I have.

MR. SCOTT: I offer photograph 13-2 in evidence.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT No. 90.

Q. 117. I hand you photograph marked 14-2 and ask you to describe it?

A. This is a picture of the froth taken through the side of the vessel, magnified 25 times, the charge made up to contain two per cent of pine tar oil.

Q. 118. You have indicated the top of the froth.

A. I have.

MR. SCOTT: I offer photograph 14-2 in evidence.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT No. 91.

Q. 119. I hand you photograph 21-1 and ask you to state what is represented?

John Warne Phillips.

A. Photograph of froth taken through the side of the vessel, magnified 225 times and the charge made up to contain one-tenth of one per cent wood tar oil. The photograph does not extend to the top of the froth.

Q. 120. That is on account of this being more highly magnified, I presume?

A. Yes—well, it does go just to the top.

Q. 121. The top ends near the top of the photograph?

A. Yes.

Q. 122. This 21-1 indicates the froth that you have said was thin and tender?

A. Yes.

MR. SCOTT: I offer photograph 21-1 in evidence.

> Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT No. 92.

Q. 123. I hand you photograph 22-1 and ask you to describe it?

A. This is a picture of the froth taken through the side of the vessel, magnified 225 times, the charge made up to contain three-tenths of one per cent wood tar oil. The froth extends beyond the edge of the photograph.

Q. 124. This also is one of the two froths that you referred to as being thin and tender, I think.

A. Yes, sir.

MR. SCOTT: I offer photograph 22-1 in evidence.

> Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT No. 93.

John Warne Phillips.

Q. 125. I hand you photograph 9-1 and ask you to state what it represents.

A. Picture of froth taken through the side of the vessel magnified 225 times and the charge made up to contain four-tenths of 1% of pine tar oil. The froth extends beyond the top.

Q. 126. At the top?

A. At the top; yes, sir.

MR. SCOTT: I offer photograph 9-1.

Said photograph was admitted in evidence and marked DEFENDANT'S EXHIBIT No. 94.

Q. 127. MR. SCOTT: I hand you photograph 10-1. Please state what it represents.

A. Picture of froth taken through the side of the vessel magnified 225 times and the charge made up to contain one-half of 1% of pine tar oil; the froth extends beyond the picture.

MR. SCOTT: I offer picture 10-1.

Said photograph was admitted in evidence and marked DEFENDANT'S EXHIBIT 95.

Q. 128. MR. SCOTT: I hand you photograph 11-1 and ask you what it represents.

A. Photograph taken through the side of the vessel magnified 225 times, the charge made up to contain six-tenths of 1% pine tar oil, and the froth extends beyond the picture at the top.

MR. SCOTT: I offer photograph 11-1.

John Warne Phillips.

Said photograph was admitted in evidence marked DEFENDANT'S EXHIBIT 96.

Q. 129. I hand you photograph marked 12-1 and ask you what it is.

A. 12-1 is a photograph of froth taken through the side of the vessel magnified 225 times, the charge made up to contain 1% of pine tar oil. The froth extends beyond the picture.

MR. SCOTT: I offer photograph 12-1.

Said photograph was admitted in evidence marked DEFENDANT'S EXHIBIT 97.

Q. 130. I hand you photograph 13-1. Please state what that is.

A. Photograph taken through the side of the vessel magnified 225 times, the charge made up to contain 1½% of pine tar oil. I think the froth extends to the top of the picture.

Q. 131. Looks as if it extended just about to the top, does it not?

A. Yes, to the top of the picture.

MR. SCOTT: I offer photograph 13-1.

Said photograph was admitted in evidence marked DEFENDANT'S EXHIBIT No. 98.

Q. 132. I hand you photograph 14-1. Please state what that is.

A. 14-1 is a photograph of froth taken through the side of the vessel magnified 225 times, the charge made

up to contain 2% of pine tar oil and the froth extends beyond the picture at the top.

MR. SCOTT: I offer photograph 14-1

Said photograph was admitted in evidence marked DEFENDANT'S EXHIBIT No. 99.

MR. SCOTT: I hand you photograph marked 18-3 and ask you to state what it represents.

A. It represents a photograph of top view of froth, the charge made up to contain 25% kerosene oil.

Q. 133. The ore being the Butte & Superior as used in the other experiment?

A. No, the ore in this case was—yes, the ore in this case was the Butte & Superior ore, the same ore.

Q. 134. The acid and other elements the same as these photographs you have been testifying about?

A. All the conditions being the same except the quantity of oil and the kind of oil.

Q. 135. You said 25% kerosene?

A. 25% kerosene oil.

MR. SCOTT: I offer photograph 18-3.

Said photograph was admitted in evidence marked DEFENDANT'S EXHIBIT No. 100.

Q. 136. I hand you photograph 18-2 and ask you to state what that represents.

A. 18-2 represents a side view of the same froth taken through the vessel magnified 25 times, the charge made up to contain 25% kerosene oil and the froth extends beyond the picture at the top.

John Warne Phillips.

Q. 137. Was it a voluminous froth?

A. Very voluminous froth.

MR. SCOTT: I offer photograph 18-2.

Said photograph was admitted in evidence and marked DEFENDANT'S EXHIBIT No. 101.

Q. 138. MR. SCOTT: I hand you photograph 18-1 and ask you what it represents.

A. 18-1 represents a photograph of the same froth taken through the sides of the vessel, magnified 225 times and the charge made up to contain 25% of kerosene oil and the froth extends beyond the picture at the top.

Q. 139. I notice in this picture shining spheres. Do you know whether they are oil globules or air bubbles, or what?

A. I think they are air bubbles in contact with the side of the glass and the particles are shoved over on the side.

Q. 140. The mineral particles?

A. The mineral particles.

Q. 141. So these are like air bubbles?

A. Yes.

Q. 142. Merely displaced froth?

A. Merely displaced foam that is in contact with the glass. I would like to state, with 225 magnification, that we get very little depth of the froth. We only get a picture practically of the plane through the froth and consequently when this is photographed right on the

John Warne Phillips.

froth it comes up against the sides of the vessel and we only get the froth right at that point, at the side of the vessel.

Q. 143. You don't get into the background at all?

A. Don't get into the background at all, because at that diameter or that magnifiication the froth beyond soon gets out of focus. Of course we get a little depth, but it soon gets out of focus beyond.

Q. 144. I would like to ask you if you notice in any of these other pictures with smaller quantities of oil shiny spheres similar to this.

A. I have, but not so plainly as in this one.

Q. 145. I wonder if you could pick out some there that show it, some with the smaller quantity of oil.

MR. SCOTT: I offer this photograph 18-1.

Said photograph was admitted in evidence marked DEFENDANT'S EXHIBIT No. 102.

Whereupon an adjournment was taken until 2:00 o'clock p. m.

John Warne Phillips.

Tuesday, April 24th, 1917, 2:00 P. M.

JOHN WARNE PHILLIPS resumed the stand for further

DIRECT EXAMINATION.

BY MR: SCOTT:

Q. 146. I think that before recess I had asked you about the appearance of the shiny bubbles in the 25 per cent kerosene photograph, and asked you if you had noticed the same phenomenon in any of the froths with smaller amounts of oil, and I believe this is the one that you picked out to illustrate your answer with; what is that?

A. That is 17-1, exhibit 69.

Q. 147. You may describe again how much oil is used in the making of that froth?

A. It is made up of a charge containing three-tenths of one per cent of oil mixture No. 3, and has the same magnification as 18-1, 225 times.

Q. 148. We will find that kerosene picture; is that it, 18-1?

A. 18-1, yes, sir.

Q. 149. Exhibit No. 102?

A. Yes, sir.

Q. 150. You find the shiny bubbles in them both, one with three-tenths of one per cent of the mixture and the other with twenty-five per cent of kerosene?

A. Yes, sir.

Q. 151. Please show those to the court?

THE COURT: Those white specks you mean?

A. Yes, sir. You see these are the bubbles, and those white spots are from the reflection of the light.

THE COURT: Yes; that is what you are calling attention to?

MR. SCOTT: Yes, and the fact that it was in them with both quantities of oil.

Q. 152. MR. SCOTT: I hand you a photograph designated 15-2 and ask you to state what that represents?

A. This represents a photograph of froth, taken through the side of the vessel, magnified 25 times, the charge made up to contain two per cent of eucalyptus oil. The ore in this case was a mixture of chalcopyrite and silica.

Q. 153. Not a natural ore?

A. Not a natural ore, but a prepared sample, though, of course, both of these substances are natural in nature.

Q. 154. I understand. Does that froth extend to the top of the picture?

A. No.

Q. 155. Mark about where it goes to as near as you can discern?

A. About there.

MR. SCOTT: I offer this photograph 15-2 in evidence.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT No. 103.

John Warne Phillips.

Q. 156. I hand you photograph 19-2 and ask you to describe that?

A. 19-2 is a photograph of the froth taken through the side of the vessel, magnified 25 times, the charge made up to contain one-tenth of one per cent of eucalyptus oil. The ore used is B. & S. ore. I have marked the top of the froth.

Q. 157. Are these markings supposed to be exact, or approximate?

A. Approximate.

Q. 158. Just the same as looking at that jar?

A. Yes, sir.

MR. SCOTT: I offer 19-2 in evidence.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT No. 104.

Q. 159. I hand you photograph marked 20-2 and ask you to describe that?

A. This is a photograph of froth, taken through the side of the vessel, magnified 25 times, with a charge made up to contain one-half of one per cent eucalyptus oil, the ore being B. & S. ore.

Q. 160. Butte & Superior?

A. Butte & Superior.

MR. SCOTT: I offer this photograph in evidence, No. 20-2.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT No. 105.

John Warne Phillips.

Q. 161. I show you photograph No. 15-1. Please describe it.

A. That is a photograph of froth taken through the side of the vessel, the charge made up to contain 2% of eucalyptus oil and the ore in this case was a mixture of chalcopyrite and silica; magnified 225 times; and the froth extends beyond the picture.

Q. 162. At the top?

A. At the top.

MR. SCOTT: I offer this photograph 15-1.

Said photograph was admitted in evidence marked DEFENDANT'S EXHIBIT No. 106.

Q. 163. MR. SCOTT: I hand you photograph 19-1 and ask you to describe it.

A. Photograph of froth through the side of the vessel with a charge made up to contain one-tenth of 1% eucalyptus oil magnified 225 times. The froth extends to the top of the vessel.

MR. SCOTT: I offer photograph 19-1.

Said photograph was admitted in evidence marked DEFENDANT'S EXHIBIT No. 107.

Q. 164. I hand you photograph marked 20-1 and ask you to describe it.

A. 20-1 is a photograph of froth through the side of the vessel magnified 225 times; charge made up to contain one-half of 1% of eucalyptus oil, the ore being Butte & Superior ore. The froth extends beyond the top of the vessel.

John Warne Phillips.

Q. 165. You notice in this picture the shiny spheres that I called your attention to in the other picture?

A. I do.

MR. SCOTT: I offer this photograph 20-1.

Said photograph was admitted in evidence marked DEFENDANT'S EXHIBIT No. 108.

Q. 166. MR. SCOTT: I hand you photograph 19-3 and ask you to state what it is.

A. That is a top view of froth, the charge made up to contain one-tenth of 1% of eucalyptus oil.

Q. 167. What kind of a froth did that make?

A. It has a dead surface with a few bubbles on it, and not a very permanent froth, tender.

MR. SCOTT: I offer this photograph 19-3.

Said photograph was admitted in evidence marked DEFENDANT'S EXHIBIT No. 109.

Q. 168. MR. SCOTT: I hand you photograph 20-3. Please describe it.

A. Top view of froth, the charge made up to contain one-half of one per cent. eucalyptus oil.

Q. 169. How does that froth compare with the one you last referred to?

A. That was one-tenth of one per cent of eucalyptus?

Q. 170. Yes.

A. This is much more permanent and much larger bubbles; shows a bubbly surface.

MR. SCOTT: I offer exhibit 20-3.

John Warne Phillips.

Said photograph was admitted in evidence and marked DEFENDANT'S EXHIBIT No. 110.

Q. 171. MR. SCOTT: Please describe photograph 27-1.

A. 27-1 is a photograph of froth made according to the California Technical Journal of November, 1903, but mechanically agitated.

Q. 172. In what sort of an agitator?

A. In this bar mixing agitator, the same as these other oils were agitated, and it had a magnification of 225 times and was taken through the side of the vessel; and the froth extended beyond the picture.

Q. 173. What was the ore that you used on this?

A. This is molybdenite ore.

Q. 174. And what quantity of oil?

A. The charge was made up of 15 grams molybdenite ore, 150 c.c. of water at 50° C., 2.4 c.c. smelter fuel oil equivalent to 2½ grams, and .4 c.c. sulphuric acid, and the agitation was 30 seconds.

MR: SCOTT: I offer photograph 27-1.

Said photograph was admitted in evidence marked DEFENDANT'S EXHIBIT No. 111.

Q. 175. I hand you this photograph—

MR. WILLIAMS: I think I ought to move to strike out the statement that it was made according to the California Journal of Technology because it appears on the face of it that it was not.

THE WITNESS: The charge is the same.

John Warne Phillips.

MR. WILLIAMS: I move to strike it out.

MR. SCOTT: It don't make any difference how it is on the record.

THE COURT: It may stand. The motion will be denied. If it varies the court will not attach any importance to it.

Q. 176. MR. SCOTT: I hand you photograph 27-3 and ask you to describe it.

A. 27-3 is a photograph of froth.

Q. 177. The same froth that was shown in 27-1?

A. 27-1, top view, and the charge is the same, of course.

Q. 178. You said it was the same froth?

A. Yes, sir.

MR. SCOTT: I offer this photograph 27-3.

Said photograph was admitted in evidence marked DEFENDANT'S EXHIBIT No. 112.

Q. 179. MR. SCOTT: Now, 27-2, photograph of what?

A. 27-2 is a photograph of the same froth.

Q. 180. Shown in 27-1?

A. Shown in 27-1 and 27-3, but taken through the side of the vessel and magnified 225 times.

Q. 181. Five diameters?

A. Five diameters.

Q. 182. The froth does not extend to the top of the mixture?

A. No, sir.

MR. SCOTT: I offer photograph 27-2.

John Warne Phillips.

Said photograph was admitted in evidence marked DEFENDANT'S EXHIBIT 113.

Q. 183. MR. SCOTT: Please describe photograph 28-2.

A. 28-2 is a photograph of froth through the side of the vessel magnified five diameters and the froth extends beyond the photograph. This was made, this froth was made in accordance with the California Journal of Technology, Technical Journal, of November, 1903, and the agitation was by shaking. It is a picture of froth similar to that.

Q. 184. It is in a vessel similar to the one used for this court demonstration?

A. Yes, shaken in what they call a mixing bottle, hand shaken. The charge was made up to 50 grams of molybdenite, 150 c. c. of water, 2½ grams of smelter fuel oil and .4 c.c. sulphuric acid.

MR. SCOTT: I offer this photograph 28-2.

Said photograph was admitted in evidence marked DEFENDANT'S EXHIBIT 114.

Q. 185. Did you mention the temperature?

A. 50° C.

Q. 186. I hand you photograph 28-1 and ask you to describe it?

A. 28-1 is a photograph of the same froth as 28-2, only the magnification is 225 times, instead of 25 times —15 diameters. The froth extends beyond the photograph.

John Warne Phillips.

MR. SCOTT: I offer in evidence photograph 28-1.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT 115.

Q. 187. I hand you photograph No. 23 and ask you to describe fully the procedure resulting in that photograph there?

A. Photograph No. 23 is a photograph of bubbles taken from froth from a charge containing one-tenth of one per cent eucalyptus oil, Butte & Superior ore. The magnification is 20 diameters, or 400 times. These bubbles were separated from the froth, and placed in tubes containing clear water, and were photographed through those tubes.

Q. 188. Explain that a little more fully; I don't quite understand.

A. The bubbles were taken from the froth.

Q. 189. With a spoon or ladle or something?

A. With a glass tube put down in the froth and put your finger over the top and cut out a section of the froth, and that tube was put down in a basin of clear water again and the tube bent over sideways so as not to allow the clear water to enter the tube, and any bubbles that were broken, the sediment would fall to the bottom; then I took another tube of clear water and transferred some bubbles from that tube, under water, into this second tube, in order to get clear water. Small corks were put in the end of that tube, and it was taken out and photographed.

Q. 190. And these bubbles were inside of that tube?

A. Inside of the tube. You can sort of see the line of light of the tube, that line on the photograph.

Q. 191. And this other line, is that also the tube?

A. No, that is a sort of reflection of the side of the tube.

Q. 192. Everything we see here is inside the tube?

A. Everything is inside the tube.

MR. SCOTT: I offer this photograph No. 23 in evidence.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT 116.

Q. 193. Please describe photograph No. 24?

A. No. 24 is a photograph of bubbles made the same as photograph 23. The magnification is the same, 400 times, and the bubbles were taken from froth made from a charge containing one-half of one per cent of eucalyptus oil.

MR. SCOTT: I offer photograph 24 in evidence.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT No. 117.

Q. 194. Please describe photograph No. 25?

A. Photograph 25 is a photograph of bubbles made in the same way, the magnification 400 times. The bubbles were taken from froth from a charge containing one-tenth of one per cent oil mixture #3.

MR. SCOTT: I offer photograph 25 in evidence.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT 118.

John Warne Phillips.

Q. 195. Photograph 26, please state what that is?

A. It is a photograph of bubbles made in the same way as the preceding; magnification 400 times. The bubbles were taken from a charge containing one-half of one per cent of oil mixture #3.

Q. 196. This is the same oil mixture #3 that you previously referred to?

A. Yes, sir.

Q. 197. And the procedure here was the same as in these other pictures of bubbles?

A. The same.

MR. SCOTT: I offer photograph 26 in evidence.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT 119.

MR. WILLIAMS: Did you state what the ore was in these last four?

THE WITNESS: Butte & Superior ore, in all those bubbles.

Q. 198. MR. SCOTT: I hand you photograph 29.

A. It is a photograph of bubbles made in the same way, but the magnification is 256 times; 16 diameters. The bubbles are taken from froth from a charge containing one and a half per cent of oil mixture. That is not oil mixture #3.

Q. 199. That is not #3, but the other oil mixture you described?

A. Yes, sir.

MR. SCOTT: I offer photograph 29 in evidence.

John Warne Phillips.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT 120.

Q. 200. And the ore?

A. Butte & Superior.

Q. 201. I hand you photograph No. 30. Please describe it?

A. Photograph of bubbles made as in the preceding photograph. The magnification is 576 times, 24 diameters.

Q. 202. The oil?

A. The quantity of oil was one and a half per cent oil mixture; Butte & Superior ore.

MR. SCOTT: I offer photograph 30 in evidence.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT 121.

Q. 203. I hand you photograph No. 31; please describe it?

A. Photograph 31, photograph of bubbles made as in the preceding; magnification of 576 times. The bubble was taken from froth from a charge containing two per cent eucalyptus oil, and the ore used was a mixture of silica and copper pyrite.

MR. SCOTT: I offer in evidence photograph No. 31.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT 122.

Q. 204. Please describe photograph No. 32?

John Warne Phillips.

A. No. 32 is photograph of bubbles made as in the preceding; magnification 576 times. Bubble taken from a charge containing two per cent eucalyptus oil. The ore used was a mixture of silica and copper pyrite.

MR. SCOTT: I offer photograph No. 32 in evidence.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT 123.

Q. 205. I take it that this photograph represents the apparatus used for making these froths?

A. Yes, that is the apparatus used in making these froths or most of them.

MR. SCOTT: I offer this photograph last referred to by the witness.

Said photograph was admitted in evidence marked DEFENDANT'S EXHIBIT 124.

Q. 206. Now, in making these froths represented in these photographs, were a large number of each individual photograph made for the purpose of selecting or did you go right ahead from one to another, take them, we might say, as they came?

A. We repeated no froth except in the smaller percentages of oil, like one-tenth of 1%.

Q. 207. Are those the two that you referred to as being rather thin and meager?

A. Yes. I think these froths were repeated about three times; but in all others we went straight ahead and in no other case was a froth repeated.

John Warne Phillips.

Q. 208. Simply photographed the first one you made with each quantity, with that exception?

A. Photographed the first one we made.

Q. 209. Now, if it wouldn't take too long, I think it would be good to state approximately the thickness of these different froths. You can designate them by your own symbols, that appear on the photographs.

MR. WILLIAMS: You mean the height?

MR. SCOTT: Thickness of the froth.

MR. WILLIAMS: The height, is that what you mean by the term "thickness"?

MR. SCOTT: It may be that your selection of language is more accurate. I think of it as '"thickness". If more pleasing to you we will change the form of the question to "height."

A. I have the thickness of most of the froths and those that I didn't take, of course I omitted, but I thought the photographs themselves would speak for the depth of the froth, but I have most of them. Photograph marked No. 16—

Q. 210. That would apply to 16-1, 16-2 and 16-3, all?

A. Yes, 16-1 and 16-2 and 16-3. The froth of test 16 in the photographs 16-1, and -2 and -3, was one quarter of an inch thick. The froth from test No. 17, as indicated in the photographs 17-1, 17-2 and 17-3, the froth was one-half inch thick. In test No. 1, I have no measurement of the froth. Test No. 2, represented by photographs 1, 2, and 3, the froth was 11-16 inches thick. In test No. 3, represented by photo-

John Warne Phillips.

graphs 1, 2 and 3, the froth was three-quarters of an inch thick. In test No. 4, representing photographs 4-1, 4-2, and 4-3, the froth was 13/16 of an inch thick. In test No. 5, representing 5-1, 5-2 and 5-3, the froth was 11/16 of an inch thick. In test No. 8, representing photographs 8-1, 8-2 and 8-3, the froth was 11/16 inches thick. In test No. 9, representing photographs 1, 2 and 3, the froth was ⅜ of an inch thick, very large bubbles. In test No. 10, representing photographs 10-1, -2 and -3, the froth was 7/16 inches thick.

In test No. 11, representing photographs 1, 2 and 3, the froth was 6/16 or ⅜ inches thick. In test No. 12, representing photographs 12-1, 12-2 and 12-3, the froth was one-half inch thick. In test No. 13, representing photographs 13-1, -2 and -3, the froth was 6/16 inches thick.

MR. WILLIAMS: Three-eighths?

A. Three-eighths. In test No. 14, representing photographs 1, 2 and 3, the froth was ⅜ inches thick. Test No. 15, representing 15-1, 15-2, the froth was three-quarters of an inch thick. Test No. 16, representing photographs 16-1, -2 and -3, the froth was 1¼ inches thick. Test 17, representing photographs 17-1, -2 and -3, the froth was ½ inch thick. Test No. 18, representing photographs No. 18-1, 18-2 and 18-3 the froth was an inch and a quarter thick. Test No. 19, representing photographs 19-1, 19-2 and 19-3 the froth was 5/16 of an inch thick. In test No. 20, representing photographs 20-1, 20-2 and 20-3, the froth was one-half inch thick. Test No. 21, representing photograph

21-1, 21-2 and 21-3, the froth was 1¼ inches thick. In test No. 22, representing 22-1, 22-2 and 22-3, the froth was ⅝ inches thick. That is all of them.

Q. 211. In making these photographs have you any recollection or record of about the length of time that elapsed after the froth formed and before the photographic plate was exposed, that is, the intervening time between the formation of the froth and the exposure of the plate?

A. I have.

Q. 212. I don't know that it is necessary to go into detail for each picture, but I would like to know, in a general way, the average.

A. Here is test No. 2. The test—After stirring up the mixture we let it settle for about five minutes, then we took plate No. 2-1. Say this was 1.30. At 1.30 in the afternoon we took plate No. 2-1 and in that case we took two pictures, two plates of No. 2-1. The first was not long enough exposed. And then at 1.53 we took 2-2, and at 2.07 we took 2-3, so these photographs were taken in that order just as soon as practicable, we took them. First the froth is formed and allowed to stand from three to five minutes and then the photographs were taken, and were taken of course, 1, 2 and 3, as soon as possible with a certain interval, sometimes 5 minutes between the plates, sometimes 10, but never over 15. So the time lapsing between the forming of the froth and the last photograph would be less than an hour.

Q. 213. Somewhere near an hour possibly?

John Warne Phillips.

A. Somewhere near an hour. But less than an hour.

Q. 214. Can you repeat a few typical instances of this, illustrate here in court with the apparatus you used?

A. I think I could.

MR. SCOTT: If the court will indulge me a moment while we get the table in and the little bar mixer, we will show a few instances and if the other side desides any particular one of these that were performed we will be pleased to select the one they want. Otherwise we will pick out a few ourselves.

THE COURT: Where have you your supplies?

MR. SCOTT: They are right upstairs in a room, and they have been told and they are all ready to carry them right in.

THE COURT: Very well, have them brought down promptly.

Q. 215. MR. SCOTT: What experiment do you propose to perform?

Test No. 3.

A. Take four-tenths.

Q. 216. Of what?

A. The oil mixture.

Q. 217. With what ore?

A. Butte & Superior ore. We have a 60 gm. charge.

Q. 218. Now, Mr. Phillips, if you will describe the charge that you have placed in the jar?

A. The charge is made up of 60 gms. of Butte & Superior ore, and of 250 c.c. of water at about 75° F.;

also 2 drops of copper sulphate solution, which is equivalent to one-tenth of one pound of copper per ton of ore, and sulphuric acid was added equivalent to eight pounds of 60° Be. acid per ton of ore. I will now agitate the pulp before the addition of the oil for half a minute, so as to thoroughly mix the pulp through the water, which gives natural conditions.

(Witness turned on electric motor with small impeller attached.)

Q. 219. MR. WILLIAMS: At what rate of speed—how many revolutions does that impeller run?

A. I think it is run near 1,800, but I don't know.

Q. 220. MR. SCOTT: You may proceed, Mr. Phillips, and you may investigate that afterwards for Mr. Williams.

A. Now, in making a one-tenth of one per cent oil charge, it requires three drops of oil, so that four-tenths of one per cent would require 12 drops of oil. I will now agitate the charge again.

Q. 221. How long are you going to agitate the mixture?

A. I am going to agitate it eight minutes, which was the time I agitated the mixtures for the photographs.

Q. 222. Is it necessary to agitate it that long, do you think?

A. No, in some cases it is not.

Q. 223. You did that merely for uniformity, I suppose?

A. For uniformity. Any time between five and ten minutes, or sometimes less would do, but I did that for uniformity.

John Warne Phillips.

A. Eight minutes agitation.

Q. 224. Now, Mr. Phillips, when that settles a little bit I would like to have you show it to the court. Have you an extra jar, Mr. Phillips, so we can keep that one while we make one with a larger quantity?

A. I have, yes sir.

Q. 225. Now, if you will go right ahead, Mr. Phillips.

A. In making another one—

Q. 226. (Interrupting.) I think the largest of this series was 1½% of the oil mixture, that is, photographs 5-1, 5-2 and 5-3?

MR. WILLIAMS: 1.5.

Q. MR. SCOTT: 1.5% of the same oil mixture, that being .4 of a per cent that you have just made.

(The witness performs the experiment.)

Q. 227. That corresponds, does it, to photographs 5-1, 5-2 and 5-3?

A. Yes, sir.

Q. 228. I mean the charge?

A. This charge corresponds to photographs 5-1, 5-2 and 5-3, contains 60 grams of ore, 250 c.c. of water, about 75° F., and sulphuric acid equivalent to 8 lbs. of 60° Be. acid to a ton of ore, and copper sulphate equivalent to one-tenth of one pound of copper per ton of ore. Agitated one-half minute before the oil was added and then added oil No. 3, 42 drops of oil mixture, No. 3, which is equivalent to 1½% of the ore added, and the amount of oil which is equivalent to

one-tenth of 1% of the ore added. Instead of being exactly 3 drops was 2.8 drops by calculation in letting a large number of drops flow, so that makes—that 42 drops of oil equivalent to 1½% instead of 45 drops as would be in the other case. We agitated it eight minutes.

MR. SCOTT: If there are any details you wanted, I would rather you would ask them and have them put on the record, Mr. Williams.

THE COURT: Any of the aides of any of you that desire to examine this of course can step up to the edge and do so.

MR. SCOTT: Mr. Phillips, now for just one more of these, can you reproduce one, I think No. 18, with 25% of kerosene?

A. I think so, yes, sir.

Q. 229. 18-1, 18-2 and 18-3 are of a froth made with 25% of kerosene.

A. Yes, sir.

Q. 230. You haven't another one of those jars have you?

A. No, we will have to clean one of these jars.

MR. SCOTT: After everyone has examined that we can throw one of those out.

Q. 231. Referring to this last demonstration, Mr. Phillips, with 1½% of that oil mixture, I understood you to say before that you adopted a uniform period of agitation of about eight minutes?

A. Yes, sir.

Q. 232. You did that simply for the purpose of comparison of the different froths?

John Warne Phillips.

A. Yes.

Q. 233. Would you regard this one that you have just made as requiring that long agitation to make a froth?

A. I should not.

Q. 234. If it had been your aim to carry out the operation most efficiently would you have adhered to that eight minutes?

A. I would not.

Q. 235. You wanted to explain something about the oil mixture. In these photographs it is oil mixture, the second one you described?

A. Yes.

Q. 236. Not the No. 3, but the other one.

A. Not No. 3. And in this experiment only No. 3 was used.

Q. 237. That was because it was available or why?

A. That was because the other oil mixture was not available.

MR. SCOTT: Will you empty one of those jars?

MR. WILLIAMS: Empty the one with the 1½%. We would like to keep the one with the four-tenths per cent, although we would like to keep them both.

MR. SCOTT: Take the 25% of kerosene test, No. 18, that will be all I will ask you to do.

Q. 238. Is this the same apparatus that you used in the test for the photographs?

A. This is the same apparatus that we used for a part of them and the other part I used an apparatus similar to that, but it is in Chicago.

John Warne Phillips.

MR. WILLIAMS: While we are waiting, have you any accurate data which will enable you to tell us the speed of rotation of that impeller when it is in operation?

MR. SCOTT: Is it marked on the machine, Mr. Phillips? Sometimes they are.

MR. PHILLIPS: No, it does not give the speed.

MR. SCOTT: And the diameter of the impeller is about three-quarters of an inch; is that right?

A. It is.

Q. 239. Is this going to be eight minutes, too?

A. No, a half minute now to mix it up.

Q. 240. But finally, I mean?

A. Agitated four minutes, the same as the last, the one in the photograph.

Q. 241. Make it the same then, four minutes.

Q. 242. You may describe the charge you have put in the jar?

A. 60 gms. of Butte & Superior ore, 250 c. c. of water, copper sulphate equivalent to one-tenth of a pound of copper per ton of ore; sulphuric acid equivalent to eight pounds of 60° Be. acid per ton of ore; and 25 per cent of kerosene.

Q. 243. Reckoned on the weight of the ore?

A. Reckoned on the weight of the ore. The kerosene is of the specific gravity of .815, which would be equivalent to 18.4 cubic centimeters of oil. We will agitate this four minutes, as I have a record of four minutes for this mixture.

MR. WILLIAMS: Do you know the Baume measurement of that kerosene?

John Warne Phillips.

A. No, I do not.

(Agitating machine was run for four minutes.)

MR. WILLIAMS: On behalf of the plaintiff I would like to test that apparatus that he used in court.

MR. SCOTT: For speed, you mean?

MR. WILLIAMS: We would like to do some of these things with it.

MR. SCOTT: All right.

Q. 244. Do you find, Mr. Phillips, that this 25 per cent of kerosene froth is made up of bubbles or not?

A. I do; I find it is made up of bubbles.

Q. 245. How about the one you made with one and a half per cent—that is gone, but you remember it I guess. This one is the four-tenths of one per cent.

A. I think it was made up of bubbles also.

CROSS-EXAMINATION.

BY MR. WILLIAMS:

X-Q. 246. In the three experiments you did in court you added sulphate of copper, was it?

A. I did.

X-Q. 247. Did you do that in all the other experiments?

A. All the other experiments.

X-Q. 248. So that every experiment that you have described here, in addition to what you described in your testimony, you used sulphate of copper?

A. I think I did. I think I outlined my charge at the first and all these experiments were made prac-

John Warne Phillips.

tically on the same charge with the exception of the quantity of oil changing and the variety of oil. that the charge was 60 grams of ore, 250 c. c. of water and enough copper sulphate to be equivalent to one-tenth of one pound of copper per ton of ore, and enough sulphuric acid to be equivalent to 8 pounds of 60° Be. sulphuric acid per ton of ore, and then I agitated that mixture for one-half a minute so as to thoroughly moisten the pulp so that we would have the condition in the test as would prevail in the mill, and then added the oil and proceeded to the agitation from the addition of the oil, not taking into account the half minute used in stirring up the pulp in the time of agitation.

X-Q. 249. And in all these operations did you put the stirrer down to the bottom of the jar as you did those that were done in court?

A. I did. I operated the apparatus as I thought it was constructed to be operated. That is automatic, when you shove it down it makes contact; when you draw it up it disconnects.

X-Q. 250. So that when the impeller enters the pulp it is rotating at its maximum speed and when it left the pulp it was rotating at its practically maximum speed?

A. I wouldn't say "maximum speed," but it was rotating on entering the pulp and on leaving the pulp.

X-Q. 251. That is, the apparatus is so arranged that, as you push it down it commences and starts up?

A. It starts up.

X-Q. 252. Ad as you lift it up it disconnects at some point?

John Warne Phillips.

A. It does. Supposed to be automatic in action.

X-Q. 253. That, of course, having been designed for the purpose of facilitating the mixing of drinks?

A. Yes, sir, it was.

X-Q. 254. And the ores that you used today, what was that ore? You just described it as Butte & Superior, but you didn't speak anything of its condition.

A. Butte & Superior, it was mill run No. 2. It contains 16% of zinc and 6% on an 80 mesh screen and 60% through a 200 mesh.

X-Q. 255. And is it ore that has been through the water concentration process and the tailings of that process or is it a raw ore ground up?

A. I really can't answer on that. I do not know. Mill run No. 2—I don't know.

X-Q. 256. You don't know it except by that name?

A. I know it by that name and I know it by that composition.

X-Q. 257. Now, in several of these experiments you used something which you said was labeled "wood tar oil" and in others you have used something that was labeled "pine tar oil." What knowledge have you as to the oil itself?

A. I just took the—practically had no knowledge as to the composition of the oil itself. I didn't test the oil as to its composition, but I understood that in this case the wood tar oil and the pine tar oil are very nearly the same.

X-Q. 258. What is the basis of that understanding?

John Warne Phillips.

A. I think it would be some—I can't answer.

X-Q. 259. Well, were you so informed?

A. I was so informed, and the odor, etc., would so indicate it.

X-Q. 260. And who informed you?

A. It was sent to us in Chicago from the Butte & Superior Mining Company and the can was labeled "Pine Tar Oil."

X-Q. 261. And the other one, the wood tar oil?

A. By the way, I have a sample of these oils, both the pine tar and the oil mixture.

X-Q. 262. Let us have a specimen of each. Have you the oils that you used in these photographs? We already have had specimens of what you used in court. Will you let us have specimens of the other?

A. I can.

X-Q. 263. As soon as your deposition is completed please hand them to Mr. Higgins. And this eucalyptus oil, where did that come from?

A. I purchased it at a drug store here in Butte.

X-Q. 263½. And how was it designated?

A. Eucalyptus oil. They said it was California oil and it had a specific gravity of .925.

X-Q. 264. And you have a specimen of that, of course?

A. I have a specimen of that.

X-Q. 265. Do you know whether it was Eucalyptus Amygdalina?

A. I do not. They said it was California eucalyptus and not the Australian.

John Warne Phillips.

X-Q. 266. Now, you had a made-up ore of calcopyrite and silica, can you let us have a specimen of that?

A. I can not, no sir.

X-Q. 267. You did not give us a composition of that ore?

A. I just made that up for my personal experiment is all. It was made up of a very nearly pure chalcopyrite ground fine and just mixed with pure fine ground silica, about 6% each, and that was only made in a small quantity and I have no sample of that.

X-Q. 268. Chalcopyrite is, of course, sulphide of copper?

A. Yes.

X-Q. 269. And that is a metalliferous mineral?

A. Yes.

X-Q. 270. And silica is one of the usual gangue?

A. One of the usual gangue.

X-Q. 271. Now, the magnification which characterized your photographs numbered 1 and 2, were 15 diameters and five diameters?

A. Yes.

X-Q. 272. Now, you would characterize that as enlarged 15 times and enlarged 5 times, wouldn't you, in the ordinary course of events?

A. No, sir. That would be enlarged—the diameter of the enlargement would be according to the square of the diameters on account of the area, having two dimensions.

X-Q. 273. That is to say, comparing one man three feet high and another six feet high, the man six feet

high would be four times as large as the man three feet high; is that right?

A. I would rather take another illustration, if I may. If you measure one side of this table as two feet, if the table is two feet square and you add two feet more on the side of the table, that table has 16 square feet, don't you see, instead of four. That is the area of the surface. So the magnification in that way increases it two diameters, which makes the area four times as big, which is the square of two. And so the magnification in this case would be the square of 15 and the square of 5.

X-Q. 274. Well, if you had a mechanical drawing and you made all the dimensions one-half you would call it "half size," wouldn't you?

A. Call it half size.

X-Q. 275. And then it would be one-fourth the area? Is that right?

A. It would be one-fourth area.

X-Q. 276. The fact is that the dimensions were only magnified 15 and 5 times, the dimensions?

A. I hadn't thought about the other. In making drawings we are dealing with lines which only have one dimension, and when you make it half size you make the line half as long, you see, and this is making a line half size, and you divide the area by one-quarter. so one-half an inch has only one-quarter of the area that an inch has.

X-Q. 277. I think that that is sufficiently clear, but as a matter of fact all of the dimensions in that number one are increased fifteen times?

John Warne Phillips.

A. All the linear dimensions, yes, but the areas are increased 225 times.

X-Q. 278. And all linear dimensions in the others are increased five times, although the dimensions are increased 25 times, the square of five?

A. Yes, sir.

X-Q. 279. I suppose you did this work under the direction of some one?

A. Well, no, sir, I did the work myself. I made all the tests and measurements as I did here, and I had the photographer right there with me, and he made the photographs under my direction, and I marked the plates in the dark room as soon as they were exposed, and he developed them and did the printing.

X-Q. 280. I thought you said ~~Dr~~Mr. Dosenbach helped you?

A. No, sir; I don't remember saying so.

X-Q. 281. Who laid out the plan of operation for you?

A. Mr. Hoskins and I together talked over the plans.

X-Q. 282. You received the plans, did you?

A. I suppose Mr. Hoskins did—as I understand it, I think the idea is Mr. Hoskins'. He did not receive any plans of these tests at all.

X-Q. 283. As far as you know you did them along the line of Mr. Hoskins' plan?

A. Yes, sir.

X-Q. 284. What was the highest percentage that you used of the wood tar oil or the pine tar oil?

A. I think two per cent.

X-Q. 285. And the highest percentage you used of those oil mixtures?

A. One and a half per cent.

X-Q. 286. Where did you get the kerosene from that you used in your experiments?

A. I got it upstairs in the laboratory in a bottle.

X-Q. 287. I mean when you photographed?

A. At the same place.

X-Q. 288. It was sent to you?

A. No, sir, it was in the laboratory in this building, upstairs.

X-Q. 289. When you made the photographs?

A. Yes, sir.

X-Q. 290. Were the photographs made in this building?

A. Some of them. I think it is the same kerosene that I used in the experiment here—out of the same bottle.

X-Q. 291. This is the kerosene that was in the laboratory of the defendant; it was in the laboratory of the defendant that you got it?

A. In this laboratory in this building, yes; but whether it was in their other laboratory I don't know.

MR. WILLIAMS: That is all, unless, after testing the apparatus we find that we may want to ask a few more questions for further enlightenment.

RE-DIRECT EXAMINATION,

BY MR. SCOTT:

R-Q. 292. Do you think, Mr. Phillips, that it makes any difference whether this agitat~~ion~~or is running at the moment it enters the pulp and at the moment it leaves the pulp?

A. I don't think it does; I think it makes no difference.

R-Q. 293. If you are requested to, are you willing to repeat these experiments and stop the agitator before it leaves the pulp and not start it until after it enters the pulp?

A. I am.

WITNESS EXCUSED.

FRANK R. WICKS, recalled, testified as follows:

DIRECT EXAMINATION,

BY MR. SCOTT:

Q. 1. Mr. Wicks, you have informed me that there were some errors in the tabulation which you produced and which is in evidence as exhibit 28, "Chino Copper Company, record of flotation operations for the treatment of slime vanner tailings."

A. Yes, sir.

Q. 2. You may state what these errors are, but before you do that and give the corrections, you may explain how they occurred?

Frank R. Wicks.

A. The errors were made by the clerical department in making up the statement, and they were not discovered until after we checked them over here, so that we went through and re-compiled the entire statement. I did that personally.

Q. 3. You had the figures to make the corrections from?

A. Yes; we brought them with us.

Q. 4. What was the nature of the first error that you refer to?

A. The first error here is in the first column, under "weight, dry tons"; the figure on the fourth line, 8065, was added in the total twice, so that that changes the total of that column by the amount of 8065.

Q. 5. What is the correct total then?

A. 2,064,070 is the correct total.

Q. 6. And the next particular in which there is an erroneous statement here?

A. In the next column, under the heading of "average daily tonnage" we made one or two changes; for instance, the first figure was given as 410, and we figured 573.

Q. 7. What did you figure that from?

A. The number of days shown there, 15 days, and the total weight treated during the time was 8600 tons.

Q. 8. It was simply a question of division?

A. Yes, sir.

Q. 9. What next?

A. Do you wish me to enumerate each of the changes as I go down?

Frank R. Wicks.

Q. 10. You can do it in the way that is most convenient for you?

A. There were a great many of these figures that did not enter into the original record; will it be necessary to repeat each one of them?

Q. 11. Well, you can state what the corrections are in the exhibits?

A. In the same column, the fourth line, 979 should be 1251.

Q. 12. How did that error occur?

A. In the same manner; it was an error in taking the number of days.

Q. 13. An error in computation?

A. Yes, sir. The average daily tonnage shown for the year 1915, reported as 1179, should have been 1812. All of these errors occur in taking the wrong number of days to figure against; they are really immaterial. 3,048 shown for the second quarter of 1916 should have been 3,081; and the average of our operations to date, as shown at the bottom of that column, 2999, should have been 3127.

Q. 14. The difference in the average arising from the change in the figures you have mentioned?

A. Yes, sir. Now, the next column "assay per cent copper." When we were making the corrections we thought best to change the averages from ordinary numerical averages to calculated averages, because the calculated averages are more nearly accurate.

Q. 15. Explain the difference between them?

A. For instance, the average of any one quarter or for one year, or for any actual part of the time, sometimes it is accurate enough if we arrive at the average arithmetically, if we simply add up the column and divide by the number of items. But that is not always quite accurate, because, for instance, we might have 100 tons of two per cent ore and ten tons of one per cent ore, so we could not very well add up the one per cent and the two per cent and take a numerical average of one and a half per cent, but we can take the calculated average, taking into consideration the totals, which is more accurate.

Q. 16. And you changed that column in the assay per cent of copper in the manner you have indicated?

A. Yes, sir.

Q. 17. Does it change the average?

A. No, sir; it changes the average for 1915, which was shown as .798, and it is now changed to .78. In the first quarter of 1916, which is the figure following that, .88 is changed to .89. The third quarter of 1916, .86 is changed to .82, and the average for the year 1916 is changed from .84 to .83, and the average for the first quarter of 1917, the last figure in the column, is changed from .75 to .74. The average of the entire column is changed from .814 to .804.

Now, Mr. Williams has called attention to certain errors in the tonnage in the first column, which is headed "flotation concentrates, weight, dry tons." I find that in making that up that in some way they got the tonnage of the rough concentrate during that period,

Frank R. Wicks.

instead of the tonnage of the finished concentrate—or at least during a portion of the period, so that we are changing the total tonnage for the fourth quarter of 1915 from 20,842 to 2,874. The figure following that, which depends on that, is changed from 23,285 to 4,889; and the next figures, 3915 is changed to 2952, which applies to the first quarter of 1916. The figure shown for the fourth quarter of 1915, 3668 is changed to 3676. Of course the year is changed from 13,945 to 12,990, and the total of the column is changed from 41062 to 21713.

Now, in the next column we made a few minor changes, not particularly important, but I will enumerate them. For the period July 13th to 23rd, inclusive, the figure shown as the assay per cent copper of flotation concentrate 4.90, is changed to 4.23. The third quarter average is changed from 16.93 to 16.99. Those averages are being changed, as I said, because of using the geometrical or calculated averages instead of the arithmetical averages. The first figure of the fourth quarter is changed from 23.08 to 23.43; the next figure is changed from 22.06 to 19.95.

A. For the first quarter of 1916, 21.27 is changed to 21.13. The next figure, 27.03 to 27.35. The next one, 28.07 to 29.64. The next one, 29.53 is changed to 29.64. The average for the year 1916 is changed from 26.48 to 26.47. The last figure in the column, which is the average for the first quarter of 1917, is changed from 28.63 to 28.47 and the average for the

entire column is changed from 24.175 to 25.352. You will notice that there are no changes in the dates in which the special ones were made because that was not effected. Flotation tailings, assay per cent. copper for the third quarter is changed from .47 to .48. The next figure from .54 to .56, and the next figure from .54 to .56 which is the same. The next one, .67 is changed to .68. The average for the column is changed from .539 to .543. Now, there was just one more column, "Flotation tailings per cent. indicated recovery." The average recovery for May 1 to 25 is given as 23.01, is changed to 21.40. For the period July 13 to 23, 30.37 is changed to 30.73. The next figure, 35.35 is changed to 34.88. The next one from 35.72 is changed to 28.81, and the average for the year 1915 is changed from 33.14 to 29.32. The first quarter of 1916 is changed from 25.92 to 24.25. The next one, 33.43, changed to 34.36. The next one, 35.94 to 35.68. The next one, 37.59 is changed to 37.39, and the average for the year 1916 is changed from 33.27 to 33.05. The average for the first quarter of 1917 is changed from 37.87 to 37.84, and the average of the column is changed from 34.553 to 33.139. Just one other little change in the quantity of oil used during the year 1915 given as 1.04 pounds per ton, is changed to 1.06 pounds per ton. I believe that covers all the changes made.

Q. 18. These changes in the columns headed "Percentage of Indicated Recovery," how did they arise?

Frank R. Wicks.

A. Those are also due to the changing from the arithmatical to the calculated average.

Q. 19. And the errors that you pointed out in the column "Assay Per Cent. Copper"?

A. Of flotation tailings?

Q. 20. Yes.

A. The same is true of that.

Q. 21. The change from the arithmatical to the calculated average?

A. Yes, sir.

Q. 22. I think Mr. Williams asked you when you were on the stand before to compile for April 4, the total amount of oil percentage, or the total amount of oil relative to the total tonnage that was in the ore including both circulating and original oil, and ore. That was my understanding of his question?

A. Yes. I have my figures here on that. I will read them. They will afford an explanation of the manner in which that is compiled. The dry tons of initial feed treated during that 24 hour run on April 4th was 3250 as is shown on this statement. The measurements of the circulating load show 8053 wet tons of material circulating in the 24 hours. The solids in that circulating load were found to be 6.23%. You will remember that I gave you a figure of 6.00 and 6.5% copper for the average of the two taking into consideration the difference in tonnage, figures to be 6.23%. They therefore calculate that there were 502 dry tons in the circulating load. This amount, added to the initial feed would be 3782 tons, dry tons

of total feed in the plant. We added a total amount of oil of 26330 pounds. This is equivalent to 8.1 pounds on the initial feed. Or, if it is figured, the total feed would be equivalent to 7.0 pounds per ton.

Now, the total pounds of oil circulating, which is determined by analyzing the wet circulating load, was 10495 pounds of oil circulating during the 24 hours. That circulating oil is equivalent to 3.20 pounds per ton of initial feed, or it is equivalent to 20.0 pounds per ton of the circulating feed, or figured against the total feed, that is th...

P. 2938, L. 14, insert " of initial feed is 113 pounds and the total oil," after " ton"

... that statement ... be taken one way or another. The headings are not particularly lengthy and it might possibly lead to some confusion; but with that statement that ought to make it clear.

Q. 23. Taking into account, Mr. Wicks, the circulating oil with the amount stated of initial oil pounds per ton for March 13, 14, 21 and 27, represents more ore than the total amount of oil of all kinds per ton of material in the machine, of all kinds, both circulating and original?

A. Well, if we figure the total oil against the total feed on those days I am quite positive that the pounds of total oil per ton of total feed would have been considerably greater than that, because we find that the amount of oil in the circulating load per ton of the material in the circulating load is equivalent to two and

Frank R. Wicks.

a half times the figures which would represent the initial oil, per initial ton. That is a little hard to figure, but if it is not clear, I can explain it further.

Q. 24. You mean that the middlings carry a considerably greater proportion of oil than is actually supplied to the initial feed?

A. Yes, sir. That ratio that we have established from what tests we have made would apply, for example on the 13th of March, on which day we had 24 pounds of initial oil per ton of actual feed; we would have, for every ton of circulating load on that day, we would have from 48 to 60 pounds of oil per ton of circulating feed. Do you see?

Q. 25. In other words, the circulating feed carried more oil than is supplied to the original feed?

A. Yes, sir.

Q. 26. And that excess brings the total average up?

A. Yes, sir.

Q. 27. I think you were asked when on the stand before to give some information as to the operations on November 18th, 19th and 20th of 1916, which are set forth on exhibit 26, "Chino Copper Company, Record of Flotation Operations and Retreatment of Vanner Concentrates"?

A. Yes, sir, I have some figures here on that. On November 18th, 19th and 20th Mr. Williams asked me to give him the exact percentages of different kinds of oil used on those days. Now, the original records show that on November 18th we used 3985 pounds of Barrett's No. 4 creosote and 225 pounds of Jones oil,

Frank R. Wicks.

no other oil was used. On November 19th, we used 4025 pounds of Barrett's No. 4 creosote and 200 pounds of Jones oil, and no other oil was used. On November 20th we used 4500 pounds of Barrett's No. 4 creosote and 330 pounds of Jones oil. You also asked me in connection with that to give you the percentage of the oils used on the 25th of November, which was a day during which we used 26.14 pounds of oil per ton of initial feed. On that day we used 4570 pounds of Barrett's No. 4 creosote and 240 pounds of Jones oil. On the 18th, 19th and 25th the proportion was approximately 95% of the Barrett's No. 4 creosote and 5% of the Jones oil. On the 20th the proportion was 93% of Barrett's and 7% of Jones.

Q. 28. Did you state how the errors arose in the column "Flotation Concentrate Weights, Dry Tons" in this exhibit 28?

A. Yes, sir. In making that up, they included a tonnage of rough concentrate instead of a tonnage of finished concentrate.

Q. 29. Have you a corrected table embodying these corrections which you have pointed out?

A. Yes, sir.

Q. 30. Of which you have extra copies?

A. Yes, sir. I would say that Mr. Wiser and I compiled this statement, each of us performing practically all of the operations in order that we would both satisfy ourselves that it was correct, but Mr. Wiser signed the statements because he signed the first copy or the original statement.

Frank R. Wicks.

Q. 31. The one that was put in evidence before?

A. Yes, sir.

Q. 32. But you have calculated these corrections from original data, I understand?

A. Yes, sir.

MR. SCOTT: Then I will offer this corrected statement. Any objections?

MR. GARRISON: The same objection; our standing objection only.

The statement was admitted in evidence and marked DEFENDANT'S EXHIBIT 125.

MR. SCOTT: That will be all. Have you any cross examination?

MR. WILLIAMS: Just one or two questions.

CROSS EXAMINATION,

BY MR. WILLIAMS:

X-Q. 33. Mr. Wicks, in your table of "Flotation Operations on Retreatment of Slime Vanner Tailings" under the heading of January 7, 1917, you state the assay per cent of copper to be 22.47. My calculators estimate, upon figures you have given us, the amount of copper should be 5.13. The discrepancy is so large that I will ask you to give it careful consideration, and, down that column I may say that every item of calculated assay is variant from your given assay, upon the figures given, although that is the most striking one.

Frank R. Wicks.

A. I am not certain that I have that one written up. I have no figures here that will enable me to give you that.

X-Q. 34. Well, with that suggestion of criticism on my part will you do as you did before, go over your figures very carefully?

A. I will have to send for the figures on that.

X-Q. 35. These are the computations that come from figures that you gave as to the recovery, including heads and tails and the discrepancy is so large that I think it ought to be explained.

A. All right.

X-Q. 36. Now, I asked you to furnish working drawings of the Janney machine. Are you able to do that now?

A. I made a request for them, but I didn't get them, yet.

MR. WILLIAMS: That is all for the present. I have got to go over these recalculations and will just postpone further cross examination.

MR. SCOTT: Our next witness will be Professor Taggart.

MR. WILLIAMS: I assume you do not care to put Dr. Sadtler back?

MR. SCOTT: I thought we would get all of the data that he is supposed to comment on, so as not to break his testimony again, as I was obliged to do before, in order to fill up the time.

Prof. Arthur Fay Taggart.

PROF. ARTHUR FAY TAGGART, a witness called on behalf of the defendant being first duly sworn testified as follows:

DIRECT EXAMINATION,

BY MR. SCOTT:

Q. 1. Professor Taggart will you state your full name, please?

A. Arthur Fay Taggart.

Q. 2. Will you state your education and experience in relation to mining and metallurgical matters?

A. I went to college, Stanford University, and hold a degree of Bachelor of Arts and the degree of Engineer of Mines from that university. Since graduation I have worked in various mills and done some examination work in foreign countries and for the last five years I have been instructor and assistant professor of mining engineering at Yale University and a consulting engineer associated with J. F. McClelland and L. W. Bahney at the same address.

Q. 3. Have you any connection at the present time with mining operations or mining interests?

A. None at all other than as consultant.

Q. 4. And how did you happen to become interested in flotation?

A. As a matter of academic interest rather than any other. It is more or less incumbent upon a university to keep abreast of the times, and when the discussion of flotation and the use of flotation became

broad, it was immediately up to us to try to find out what we could about the subject.

Q. 5. Were there any formal actions or conferences in the university on the subject?

A. The question of flotation seems to involve considerably more physics than is included in the working knowledge of the average mining engineer and we thought in conference in the Mining Department that it would be well to get in touch with the Physics Department and try to get the Physics Department to supply the requisite knowledge of physical phenomena, while the mining department could supply the questions and point out the particular lines of research and that then a member of the physics department and myself could work together along this particular line.

Q. 6. Did you mention at the beginning of your testimony of your having had practical mining and metallurgical training?

A. I have had.

Q. 7. You stated the facts as to your practical experience, did you?

A. Yes, I did.

Q. 8. You did not state where, did you?

A. I have worked in the mill of the Nevada Consolidated Mining Company at McGill, Nevada, and in the mill of the Montgomery Shoshone Mining Company at Rhyolite, Nevada. I worked in both those mills as an operator of various kinds of metallurgical machinery, and I have assisted, with my associates, in the designing of three or four kinds of metallurgical

Prof. Arthur Fay Taggart.

plants, that work consuming a considerable portion of my time for the last three or four years.

Q. 9. Through how long a period has your investigation of the flotation process extended?

A. About two years.

Q. 10. Have you come to any conclusion as to what are the essentials in this so-called agitation-froth flotation process?

A. First, we must agitate and aerate a pulp with some reagents which will absorb at the gas-liquid and at the solid-liquid surfaces and after such agitation and aeration the pulp should be allowed to pass to some point, a box or cell, where the bubbles which have been beaten into or passed through the froth can rise to the surface of the mixture, carrying with them the load of solid matter, which ordinarily is the sulphide that it is desired to separate. The ordinary reagents used are oils or some fatty substance, acids or alkalis. The ores usually treated are those consisting of a sulphide or occasionally some other materials of adamantine or metallic luster, and a gangue consisting of some rock not having the adamantine or metallic luster, and ordinarily valueless.

Q. 11. Have you come to any conclusion as to what the function of the oil is in the agitation froth flotation process?

A. The oil seems to have two functions; first, to aid in the formation of a stable froth; second, to act as a selective agent for the separation of the sulphide from the worthless rock—and I hope that throughout

the subsequent discussion the word sulphide will be taken to include such other few minerals as there are, which are not sulphides, and which yet are amenable to concentration by flotation. Graphite is one which is obviously not sulphide, and yet is so amenable.

Q. 12. Can you state in what way oil aids in the formation of a stable froth?

A. It acts in three ways I believe. It acts first, to reduce the surface tension of the water with which the ore is mixed. It also, by adsorption or concentrating at the surface of the bubbles, within the pulp, forms a film, at the contact of which with the water in the pulp, there is formed an interface which is markedly more viscous than either the oil or the water or the mixture of the two. Finally, the oil will vary in concentration in the bubble film in such a way as to allow the bubble film to vary its strength of resistance to external forces. In those three ways oil aids in the production of a stable froth.

Q. 13. Is there any simple experiment by which you could show, visually, that the oil does in fact reduce the surface tension?

A. There is. Would you like me to perform it now?

Q. 14. There will be time enough, won't there; it will only take a few minutes?

A. I think so, yes.

Q. 15. I will have the things gotten for you. Mr. Dosenbach knows where they are, does he?

A. Yes, Mr. Dosenbach knows.

Prof. Arthur Fay Taggart.

Q. 16. You might describe this experiment in advance?

A. I wonder if I might have the blackboard. I am rather accustomed to working with a blackboard.

Q. 17. There is one here; you may step to the blackboard.

A. (Drawing) This particular experiment that I am about to perform to show the reduction in surface tension by oil is to float a match on the surface of a body of water in a pan. The match will then appear in some such position as this (drawing). As soon as the water in the pan comes to rest, the match will be held stationary under the influence of the forces of surface tension, which are equal, and which act equally in all directions, and which I may represent by these arrows. Now, if on the surface of that pan we place a drop of oil at one side of the match—say, there—then the match will jump over against the side of the pan, away from the point at which the drop of oil is placed. The explanation of that particular phenomenon is, of course, the reduction of the surface tension of the water, due to the oil film upon it, and we find some such condition as this: If I represent this as the drop of oil, and the immediate sphere of action of the oil that spreads over the water by this curved line, then the force on this side, the surface tension, will be reduced in some such fashion as that, (drawing) while those on this side will momentarily remain as before, and of course the match will be pulled away by the preponderance of the surface force on the side away from the oil.

Q. 18. Is there any simple or graphic way that you can state, just roughly, what this surface tension is?

A. It is a pull. You can consider the surface of the water itself as a stretched skin, similar to a sheet of elastic stretched over a ring or the head of a drum. Either of those things, while they are solid, are in the same state of tension, exactly, as the surface of any body of water. If we take the particular case of the elastic film and carry the parallel further, if you should place the match on the rubber film and cut the film at one side and thus reduce the tension on that side, of course the film would spring back toward the other side and carry the match with it. You would have there an exact parallel between the surface tension of water and the tension of that elastic film, pulling the match away in both cases from the place where it originally was, due to the preponderance of force on the side away from that where the tension was reduced.

MR. WILLIAMS: Will the professor furnish us drawings of the diagrams that he is making on the board?

Q. 19. I understand you are going to furnish little drawings the same as those you are putting on the blackboard?

A. I will, yes.

(The witness performed the experiment.)

WHEREUPON an adjournment was taken until Wednesday, April 25th, 1917, at 10:00 a. m.

Prof. Arthur Fay Taggart.

Wednesday, April 25, 1917.

MR. TAGGART ON THE STAND.

DIRECT EXAMINATION Resumed.

BY MR. SCOTT:

Q. 20. You have referred, Prof. Taggart, to the formation of a viscous film at the junction of the oil and water. Can you show this by an experiment?

A. I can.

Q. 21. I will ask you to do so.

A. May I first explain by blackboard drawings what I expect to have happen?

Q. 22. Certainly.

A. Now, for the purpose of showing that at the interfacial boundary between oil and water there forms a viscous film, I am going to take a beaker and place in it, at the bottom, some water, and for the purpose of making the phenomena to be observed more easily visible, I am going to color that water with red ink, and I will represent it here as so colored. After having placed the water colored with red ink in the bottom of the beaker, I will place above it a layer of oil, which, again, for the purpose of making the phenomena more easily observed, will be colorless. Then by means of a medicine dropper inserted with the point below the oil-water interface, I will release below the oil—water interface, some bubbles. The bubbles in rising will first strike the ~~inter~~surface between the oil and water, and will drag that surface up in this fashion.

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(Figure 2) That particular phenomenon is indicative of the presence at the interface of a film which is considerably more viscous than the body of the water or the body of the oil; it will indicate more viscosity than the water, because it will have passed through the water freely until it strikes that film, and having been released from that film, as it will be later, it will pass through the oil freely, indicating, then, a greater viscosity at this interface than is present in either the colored water or oil.

(Drawing Figure 3). I will omit the medicine dropper, which, of course, will be present. Then after the bubbles have broken away through the viscous film of the interface, it will appear like this; then rising through the oil there will be the air at the center, surrounded by a film of considerable thickness of the colored water. That will pass up through the oil and arrive at the surface of the oil in some such condition as that, and when closely observed, some of these bubbles—all of them will not act in the same way—will show a red color at the surface of the oil, indicating that the film is still around the bubble. The film will have dragged down sufficiently when the bubble reaches the surface, so that the red color in some instances cannot be observed, and in those particular bubbles the condition will be this. (Figure 4)

Now, eventually both of those water coatings will drop from the bubbles and they will fall back through the oil in this cup-shaped form, and there will be apparent at the edges of the cup—the rim of the cup—

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some of the thin films that look almost like a red tissue paper. Now, it is the fact that the water, falling through the oil, preserves its shape rather than taking a spherical shape as would be ordinarily the case of a drop of water falling through a fluid such as air. That is an indication of the high viscosity of the film at the boundary between the water and the oil. According to the law that a mass will tend to a condition of least potential energy, and due to the further fact that a sphere is the solid whose surface is the least for its volume, and to the fact that with the least surface the particle of water will present the least potential energy, the particle should, if allowed to follow its tendency, assume a spherical shape. Now, the force of the surface tension that would tend to cause it to assume a spherical form, is overcome, in this instance, by the high viscosity of the film at the interface between the water and the oil, and you get, consequently, this shape, which is absolutely unnatural for a particle of water to assume, if it were not under conditions, as it is, where the viscosity of the surface is so great as to overcome the force of surface tension, tending to make it a sphere.

There will also be present in this mass of oil above the bubbles, if the bubbles are blown in with sufficient rapidity to agitate the surface of the interfacial film. particles of water shaped something like this, tadpole shape, as these are, again due to the excess of viscosity—the excess force of the viscosity of this interfacial film over the force of the surface tension of the water itself. (Figure 5)

Now, I will perform the experiment.

Q. 23. Just state, professor, what you do as you go along and the stenographer will put it down?

A. First I poured the water into the beaker and inserted the bubble blower. Then I placed red ink in the beaker and then poured on to the surface of the ink a layer of oil, kerosene oil being used.

Q. 24. About how thick is the water layer and the oil layer?

A. The layer of water and the layer of oil are approximately an inch each in thickness. Now, first you will observe the way in which the interface pulls up as the air is inserted, indicating there the viscous film at the interface. As you will have observed, very quickly, the fact that some of the bubbles as they appear at the surface are coated with the red water. The holding of this red water layer at the surface is a momentary thing, merely. Then as the water falls back from the surface the cup shaped or bowl shaped drops of water may be observed. Finally, if I blow the air through rapidly, the little tadpole shaped particles will, I think, be noticed.

Q. 25. What are you trying to show now?

A. These bowl shaped drops of red water.

Q. 26. I don't know that the court gets a clear view of it. It is like a little shred of something falling. You will have to look very closely to see it.

THE COURT: Let me play with it.

THE WITNESS: If you release the bubbles near the center you get better results.

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THE COURT: You operate it, that is your trade, not mine. I see the distorted shape of the bubbles as they drop back.

THE WITNESS: That is the thing I wished you to see.

THE COURT: I have observed that.

THE WITNESS: The cup shaped bubbles, and the fact that there is a little fringe, as it were, hanging back around the cup where the film has been drawn out to a greater extent at the very edge of the bubbles.

THE COURT: As they come to the top they break in two, part of it go back?

A. Yes, the water goes back and the air stays up.

THE COURT: That which goes back is water entirely?

A. Oh, yes. It can be none other, because the water is colored and the oil is uncolored.

THE COURT: I mean there is no air inside of that that goes back?

A. No, no, there is no air.

MR. SCOTT: How would that be, doctor, if done in a jar about a foot deep? Would we have more time to look at it as it was dropping? Would that be any better?

A. I think it would be more visible.

THE COURT: I think I see what he is trying to illustrate.

MR. WILLIAMS: I would ask if your honor has seen the thing that is pictured there?

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THE COURT: No, I have not seen the distinct cup shape, it seems to me, going back. It appears to be in rather a globular form, some of these, going back.

THE WITNESS: Yes.

THE COURT: Are these solely water or is there air inside?

A. Those are solely water, unless you can see an occasional air drop. (Here the witness agitates the solution rapidly with the dropper.) Now, you see there are a great many of these small water globules at the top and no air there except occasionally an entrapped particle.

THE COURT: Your idea is as it comes up it is air and water there and the air stops at the top?

A. Yes, and the water falls back; and, due to the fact that the water is in contact with the oil, there is sufficient viscosity at the interface to overcome the surface tension. The experiment is, of course, to indicate the high viscosity of the film at the interface between the oil and the water.

THE COURT: I observe that lifting feature. I can't say that I observe as broadly as you make it there the saucer shape, but I can observe it goes back in a flattened form. Don't you think that these are all dropping back with a convex upper surface?

A. No, sir. The larger ones are but the smaller ones are not. There, did you see that one?

THE COURT: Yes, rather flattened out, as I say. I have observed that feature.

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A. And that one?

THE COURT: Yes, that is flattened.

THE WITNESS: Of course, they will assume a spherical surface as they go down.

THE COURT: I think I understand.

MR. SCOTT: You have drawn it in section on the blackboard?

A. Yes.

THE COURT: I understand what you mean.

THE WITNESS: The edges come up just as though they were tissue paper. As you get them larger the surface tension being a function of the area, is sufficient to overcome the viscosity. The smaller bubbles are more like the conditions in the flotation process where everything is beaten very fine. Then the force of viscosity is great enough to overcome the surface force.

Q. 27. MR. SCOTT: Can you show by some experiment, other than by actual flotation operation, the fact that oil tends to select a sulphide mineral in the presence of water and that water tends to select gangue in the presence of oil? Or, in other words, can you show that in the presence of water oil will selectively adhere to a sulphide particle in the presence of a gangue particle?

A. Yes. (Witness performing an experiment.) Now, I have placed in this cell a piece of galena and a piece of quartz and covered them so that the galena is about one-half inch and the quartz about an inch

below the surface of the water. I am going to drop onto the surface of the water some drops of wood creosote, and some of the drops will, due to their momentum and the lessening of the surface tension of the water, fall through onto the respective minerals, and we will find that on the galena the oil tends to spread out over the surface, while on the quartz it tends to draw up into a globule and remain in that state. Now, if I may draw on the blackboard so it will be a little easier to see.

MR. SCOTT: I should like the record to show that we will have these sketches reproduced on paper for the record, these blackboard sketches.

MR. KREMER: That will be satisfactory to you, Mr. Williams? We will erase these and draw them on paper and submit them to you.

MR. WILLIAMS: Yes.

I think that the phenomena that we observed in the cell are presented in the sketch here (diagram 3.) The drops of oil on the surface of the galena tend to spread out and replace the water at that surface. The drops of oil on the surface of the quartz tend to draw up from it in the shape of a sphere. In other words, the water tends to push in under the oil at the quartz surface and replace the oil, so that we have then an instance of the selective action of the oil on galena or sulphide in the presence of water, and the selective action of the water on quartz or other gangue minerals in the presence of oil. It is, of course, this selec-

tion which is depended upon in the flotation process for the separation of the valuable sulphide minerals from the worthless rock.

Q. 28. BY MR. WILLIAMS: Now, professor, I observe that the oil on the quartz is a globule which is quite perceptibly flattened out at its lower end, and, although it is not of very much importance, there is no doubt that what you have drawn there is slightly different from what that shows.

A. That is right; I will bring that down a little bit. (Drawing.) I believe that would be rather more in line with the phenomenon.

MR. SCOTT: I now offer diagram No. 3 just made by the witness in evidence.

> Diagram No. 3 admitted in evidence without objection marked DEFENDANT'S EXHIBIT No. 126.

Q. 29. MR. SCOTT: You stated that the oil assists in the formation of a stable froth, and have shown by experiments the functions of the oil in such formation. What other conditions must prevail in order that the froth may be stable and persistent?

A. It must carry a load of finely divided solid matter

Q. 30. What is the effect of the solid matter?

~~matter~~.

A. It is to increase the viscosity of the film very markedly.

Q. 31. Can you show that also by a simple experi-

ment, the increase of viscosity due to the presence of solid matter?

A. Yes. (Drawing.) I will attempt four different experiments here to prove that it is the presence of solid matter which causes the formation of a stable and persistent froth. In the first place, if this represents the surface of a body of water, and I have floated on that body of water a little raft, like this, —this being a part of a match stick, and this being part of a match stick, and this a needle—(The reason that I am using this peculiar apparatus is that I want to be able to move the raft by means of a magnet, without touching the surface.) Then, if I float over here a chip, I will be able to turn that raft on the surface of the water without turning the chip, showing that there is no great viscosity in the interface between the water and the gas. That will be experiment No. 1 (Figure 1).

In experiment No. 2 I will use the same device, except that in this particular case I will dust upon the surface some finely divided ore (Figure 2) and then when this raft is moved by means of the magnet, it will be seen that the chip moves with the raft. In other words, that this surface is acting as though it were a solid. The viscosity has been so greatly increased by the addition of the solid matter to the interfacial film.

(Figure 3). Now, in experiment 3 I will take the raft and the chip and will place on the surface of the water a drop of oil sufficient to contaminate the

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water and lower the surface tension. At the interface between the oil and the water, there will be a viscous film which is characteristic of such an interface, and it will be seen that when I turn the raft, that the chip itself will not turn. By ordinary visual methods of measurement, as it were, there will not have been a sufficient increase of stability and viscosity of the surface by the mere addition of the oil to cause the increase in viscosity which is necessary to the formation of a stable and persistent film. Finally, (Figure 4), taking the same case, this oil-covered surface, I will dust some fine ore on it, and it will be seen that the chip again moves with the raft; that the surface has been stabilized and made highly viscous, viscous to the point of acting almost as a solid surface by the introduction of the finely divided solid matter into the film.

I will now perform the experiment. (A pan of water, the raft and a chip.) You will see that I can move this raft and there is no corresponding motion of the chip. (Adding dust.)

Q. 32. MR. WILLIAMS: What material have you dusted in there?

A. I think that is some Butte & Superior ore.

Q. 33. BY THE COURT: Where is that chip?

A. The chip is over here. There must have been some grease on it from carrying it in my pocket, which causes the film to pull away from it. Now, you will notice that I can move the entire surface.

Q. 34. MR. SCOTT: How would it do to add a new chip?

A. I hardly think it would make any difference.

Q. 35. BY MR. WILLIAMS: Cut two or three chips off so as to get down to a clean surface.

(Witness cutting several chips off pencil.)

Q. 36. BY THE COURT: Does your magnet act on the ore as well as on the needle?

A. Not on this ore; at least that is the presumption. I think that I can show here that it does not. (Sticking magnet in a bunch of ore.) I think it can be seen very obviously that the whole surface there moves. (Holding magnet near raft).

Q. 37. BY THE COURT: If you took your pencil would it move that scum?

A. I will try that. Yes, it does.

Q. 38. What does this illustrate now?

A. The increase in the viscosity of this interface between the gas and the liquid by introducing into that interface the finely divided solid particles.

Q. 39. Then it does not matter how you move the raft?

A. Not at all, not at all. Now, I will take another small pan, and I will put in water and the raft and a chip and I will add some wood creosote oil. There is on doubt of the contamination of the surface there.

Q. 40. BY THE COURT: What is this?

A. Here I am going to show that the increased viscosity of that interface is due to the introduction

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of solid matter, rather than to the introduction of the oil.

Now, you will see that the raft can be moved without the sphere of influence of the movement of the raft extending to the chip, although it can be seen by observing the film between the two arms of the raft, as it were, that that surface itself is acting like a solid; that is, the increase of the viscosity of the surface by the oil is sufficient to cause it to act almost as a solid through small distances, but that it is not sufficient to make it act as a solid over a considerable distance, and does not indicate the high viscosity that will be indicated when I put the ore on. (Sifting on ore dust.)

The surface has become so tough now that I have to get very close with the magnet to influence the needle.

Q. 41. BY THE COURT: Your mineral breaks up.

MR. SCOTT: It needs more mineral, I guess.

(Witness added more dust.) I think the motion is shown here ahead of the raft, practically under my finger.

MR. SCOTT: I offer the diagram just made by the witness and marked "No. 4, A. F. T."

Diagram admitted in evidence and marked DEFENDANT'S EXHIBIT 127.

Q. 42. Now, Professor Taggart, will you explain the relation of the experiment you have just performed to the permanency of the film, in flotation operation?

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A. I stated yesterday that the functions of oil in the flotation process were two: First, to assist in the formation of a stable froth; second, to assist in the selection of the sulphide mineral from the gangue. I said that the ways in which the oil assisted in the formation of a stable froth were: first, to decrease the surface tension of the water in the pulp, and I showed the decrease in the surface tension of water by means of oil, with the experiment No. 1. Then I stated that at the interface between oil and water there was formed a film whose viscosity was markedly greater than that of either the water or the oil or of the mixture of the two; and I showed that this morning by means of the experiment No. 2, the colored water bubble experiment. I said there that the oil assisted in the formation of a stable film by concentrating in the film and, being present in the film as a contaminant, having the power to move in the film and thus change the oil concentration in the film at any point in a direction which would tend to increase the resistance of the film to external forces. That I have not been able to illustrate by experiments. It is a matter, rather, of reasoning. Then, the other function of the oil, the selective action for sulphide as compared to gangue, is illustrated in experiment No. 3, in which it was shown that the oil tended to displace water at the surface of the sulphide particle, and that water tended to displace oil at the surface of the gangue particle. It is true, however, that in addition to the stabilizing influence of the oil alone, it is necessary for the for-

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mation of a persistent froth that there be present in the bubble film a load of solid matter, and the effect of that load of solid matter in stabilizing and making persistent the bubble film is shown in experiment No. 4 just performed.

Q. 43. If we were to shake a bottle containing water and a little oil and then afterwards to shake a bottle similarly containing water and oil, but in addition powdered ore, is it your opinion that the result of the two operations would confirm the conclusion drawn from your experiment with the little raft this morning?

A. Yes, sir.

Q. 44. In the first instance, what would happen?

A. In the first instance, you would get some bubbles that would persist for perhaps a fraction of a second or a second, but obviously longer than they would persist if pure water alone had been placed in the bottle. In the second instance, you would get some bubbles that would persist considerably longer than the bubbles with oil and water alone. Just how much longer I would not dare say because that is a question of the quantity of sulphide present and the degree of agitation.

Q. 45. The second operation, with the oil, water and ore, is illustrated, is it not, by the two tubes containing the molybdenite froth which stand before the court?

A. That is what you should get with consider-

able agitation. I did not see those experiments performed so that I do not know.

Q. 46. Can you state generally the condition necessary for the commercial success of a flotation process, as to the material treated, and so forth?

A. There are two conditions. First, that the solid material which passes into the froth shall be preponderantly sulphide, assuming that you are attempting to concentrate a sulphide from a worthless rock; and, second, that a very large percentage of the total sulphide present in the feed to the apparatus shall pass into the froth.

Q. 47. What is the effect of the emulsification of the oil and the agitation, as practiced in the flotation process?

A. As the process is ordinarily practiced the pulp containing the proper reagent, is placed into a device for agitating it violently. The idea of such agitation is to break up the oil that has been introduced into an extremely large number of extremely small particles or globules and at the same time to cause a certain number of the sulphide particles present in the feed to meet or come in contact with those oil globules and become coated with oil. Of course, at the same time that the sulphide particles are coming into contact with the oil globules, particles of gangue are also coming into contact with them, but, due to the tendency of the oil to replace water at the surface of sulphide, the sulphide particles will become

coated with the oil; and, due to the reverse tendency of the water to displace oil at the surface of gangue particles, the gangue particles will become coated with water. Then after the agitation in this primary agitator, in the so-called "emulsifying cells," the pulp is passed to another agitator which is so arranged that there is a circuit through into a box, a settling or separating box, in which there is no agitation and from which the pulp can pass back again either into the cell which it just left or through suitable passages into another cell. In these so-called "beater cells" of the process the pulp is filled with an enormous quantity of small air bubbles. Then, during the process of agitation, these bubbles, in a purely mechanical manner, and under the ordinary laws of probability, will come into contact with either small globules or oil-coated sulphide particles, or both, or neither. Those bubbles which come into contact with an oil globule or an oil coated sulphide particle will immediately become coated at the air-liquid contact surface with a thin layer of oil. We have then the condition for concentration, for the separating of the sulphide particles from the gangue particles. That is, we have an air bubble surrounded by an oil film, and outside of that oil film the watery mass of the pulp. We have then, at the surface of the air bubble, a low surface tension due to the contaminant which is absorbed or concentrated at the interface between the gas in the bubble and the surrounding liquid. There is

present the viscous film which is characteristic of the interface between oil and water. We have also a place at which the sorting of the sulphide from the gangue can be done, and as sulphide particles and gangue particles are present in this interface for sorting, the sulphide particles, owing to the tendency of oil to replace water at the surface of the sulphides, will pass into the oil layer at the surface of the bubble; while the gangue particles, due to the tendency of water to displace oil at the surface of gangue particles, will be rejected at that interface and passed back into the mass of the water. Now, in a mass where there are present such stupendous numbers of bubbles and oil globules and oiled sulphide particles and unoiled sulphide particles it is obvious that there will be a stupendous number of chances offered for the sulphide particles to stick to and stay at the surface of the bubbles. When the bubbles arrive at the surface of the liquid, as they will when the pulp passes out into the separating chamber and there is a quiet place offered for the difference in specific gravity to allow the solid coated bubbles to so rise, there is a sufficient coat of sulphide particles to stabilize the bubbles and cause them to be persistent for a sufficient length of time to allow them to be scraped off or taken off by some means from the surface of the box and thus be separated completely from the gangue, which sinks in the box and is carried out at another point. The froth that rises will, of course, be pre-

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dominately sulphide and the solid that sinks and passes out in the so-called tailings discharge of the machine will be predominately gangue.

Q. 48. What is your opinion, Mr. Taggart, as to the effect of acid in the agitation-froth flotation process?

A. I think the acid has perhaps two functions. In the first place, acid tends to absorb at the surface of gangue particles, that is to concentrate at the surface of gangue particles, in a manner exactly similar to that in which oil tends to absorb or concentrate at the surface of water. Now, the result of this tendency of acid or acidulated water to absorb at the surface of gangue particles is to insure that the gangue particles will be wet with—that is will pass into and will remain in—the water part of the pulp. The acid also aids in flocculating or agglomerating into rather large masses the very fine particles of gangue and thus aids in keeping these gangue particles out of the concentrate froth.

Q. 49. Have you formed any conclusion as to the effect of heat in the flotation process?

A. Heat, I think again has two functions. In the first place, it decreases the viscosity of the oils and hence aids in the distribution of the oil at the surface of the air bubbles. Even more prominently, however, it acts as a means of flocculating the finely divided gangue; and this flocculation is almost essential.

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Q. 50. What is the word you use?

A. Flocculating, that is the drawing together into masses of a lot of small particles. This flocculation is almost essential to the production of a clean froth; that is, one that is not carrying a considerable proportion of gangue.

Q. 51. MR. WILLIAMS: Clean concentrate, did you say?

A. Clean concentrate, yes.

Q. 52. MR. SCOTT: You have stated that this flocculation of the finely divided gangue caused a reduction of the percentage of gangue in the concentrate, but have you any explanation for that statement?

A. In the agitation in the so-called emulsifier cells and in the subsequent agitation in the beater cells of the flotation machine it is unquestionably true that an even larger amount or proportion of gangue particles is presented to the bubble surface than of sulphide particles, provided that the amount of gangue present in the feed is greater than that of the sulphide. The force tending to reject the gangue is a function of the surface of the particles, of the area of the surface. The greater the area, the greater this force. The film at the bubble surface or surrounding the air in the pulp is viscous, as we have shown, and in the case of these various small particles of gangue the viscosity of that film may be sufficient to hold the gangue particles in there against the force—the surface force, tending to throw them out. Now when the fine par-

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ticles are agglomerated together or flocculated, they present a very considerably increased surface, and there is consequently an increase in this surface force, and the increase in the surface force is greater than the increase in the periphery of the agglomerate with respect to the original particles. The force of the viscosity at the interfacial film is a function of the circumference, as it were, of this flock. The periphery of course, as you increase the flock, increases as the radius, or as the diameter, in other words as the first power of that particular dimension of the body, while the area of the surface increases as the square of the radius. Consequently as you increase the size, you increase the area as the square of the radius and increase the surface force as the square of the radius, while you increase the circumference only as the first power of the radius and, hence, increase the viscosity only by the first power of that particular function; so that the increase in the surface force then is greater than the increase in the viscosity, with the increase in size of the particles; and consequently the surface force will tend to throw the larger flocks out while it is not sufficient to throw the smaller particles out against the viscosity of the film at the bubble surface.

I might say here that the increase in surface force is even greater than the increase of the square of the radius, due to the irregular shape of the surface of the flock. If the small particles which are flocked together are spherical, then the reasoning as to the

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first power and the second power of the radius would hold directly; but where the particle has a very much greater surface due to its corrugations than the sphere, then the increase in the surface power is even greater than would be true in the case of the sphere.

Q. 53. Is there anything in the theoretical basis of the agitation-froth flotation process that indicates a critical point in the quantity of oil relative to the ore?

A. Absolutely none that I can see.

Q. 54. What are the conditions that determine the amount of oil that must be used?

A. I think that the amount of oil that must be used depends upon three things: The amount of sulphide matter that is present in the feed, the amount of water that is present in the feed, that is, the degree of dilution, and the degree of aeration in the feed.

Q. 55. Will you state the relation between the amount of aeration or agitation and the amount of oil necessary?

A. If we consider in a cell or in a particular operation all things constant, except the degree of aeration, then any particular bubble in the machine will have a path whose average length is the same. There will, of course, be some bubbles that will go through the machine very quickly; there will be some bubbles that take a long time, that pass around and around in the beater cells before going out into the Spitzkasten; but taking the average of all the bubbles in the machine, then most of the bubbles will not depart very greatly from this average. The number of bubbles and the size of

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the bubbles with a given degree of agitation will also be approximately a constant. The number of globules of oil and the size of the globules of oil and the number of particles of sulphide—coated and uncoated with oil—will all be approximately constant figures, other conditions being the same, with a given degree of agitation. This means, then, that each oil bubble will carry approximately the same amount of oil, will have met approximately the same number of globules of oil and the same number of oiled particles; consequently there will be a certain quantity of oil required to coat a given quantity of bubbles. If, now, by increasing the agitation, you beat in twice as many particles of air, the other things remaining constant (the number of particles of various things)—the number of bubbles will increase; we may assume for the sake of argument that they double, which they may not, of course, and if you have had present in the first instance just enough oil to coat the number of air bubbles that were present with the first degree of agitation, you will obviously not have enough oil present to coat the greater number of bubbles that will be formed with an increased amount of agitation; therefore, as you increase the degree of agitation it will be necessary to increase the amount of oil that is to be used, if it is expected that the bubbles are going to arrive at the surface coated with a sufficient quantity of oil to perform their function in the process.

Q. 56. Now will you state similarly what the relation is between the amount of sulphide present in the ore and the amount of oil necessary?

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A. The reasoning, of course, is entirely similar. In order to coat a given number of sulphide particles with oil—and you must assume that the great majority of the sulphide particles that are saved must be coated with oil—it is necessary to have a film of some certain minimum thickness on each particle. Now, as you increase the number of particles, it means, of course, that you must increase the quantity of the oil fed into the machine in order that each sulphide particle may have its coating of the minimum thickness of oil.

Q. 57. How does the amount of water present in the pulp affect the quantity of oil necessary?

A. Other things being constant, if you double the amount of water in a pulp there will be present in each cubic foot of pulp one-half the number of sulphide particles that there were present before. It is necessary, however, in order to insure that all the sulphide particles or a very great majority of the sulphide particles in the feed shall meet a globule of oil or an oil-coated air bubble, that there shall be present in each cubic foot of the pulp a certain minimum number of oil-coated air bubbles. In order to coat these air bubbles, a certain quantity of oil must be used; but where the pulp is dilute, you have to supply this number of oil-coated air bubbles for a very much smaller number of sulphide particles than when the pulp is thicker. Consequently the amount of oil necessary will depend upon the degree of dilution; as the dilution increases, the amount of oil necessary will increase.

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Q. 58. Suppose a soluble frothing agent were used, would the dilution of the pulp have a similar effect?

A. Yes, sir.

Q. 59. I think that it is a fair statement of what you have explained that in your opinion the amount of oil necessary is dependent on the amount of sulphide in the feed and the dilution of the pulp, rather than on the amount of solid matter?

A. Yes.

Q. 60. Is it your opinion that the attachment of air directly to the sulphide particles has anything to do with the agitation froth flotation process?

A. No, it has not.

Q. 61. Have you any experimental data in support of that conclusion?

A. I have examined a large number of bubble films under the microscope, the particular method followed being to take some newly formed froth on a ring, in such a fashion that I could quickly examine, first one side and then the other side, thus insuring that I was seeing what had been the outside of the bubble and also the inside of the bubble. In such examination I have found that in freshly formed films a very large majority —and by that I mean in the proportion of ten or twenty or thirty or forty thousand to one—of the particles present in the film, are entirely within the bubble film; that with just a very few exceptions the solid particles are at no point in contact with the air. Now, there need be a little care exercised in this particular examination, be-

cause in a film that has stood for a few minutes, if the film is sufficiently loaded with solids to remain for a considerable length of time, the larger particles of solid matter present in the film will commence to poke through; they do not break up the film, but the particles poke through, and the film will draw down over them, leaving the solid particles very apparently sticking through, and such is not the condition as the fresh froth reaches the surface. If, however, you attempt to photograph, it is necessary, of course, to get a froth or a film that will stand for a considerable length of time—that is, a thick film, and I have not yet been able to photograph within the thirty seconds or a minute that are necessary, if I would insure that all the particles remain within the film—so that photographs all show some particles sticking through. However, it is possible, I think, that you can examine it here through the microscope—examine some freshly formed films and see that the particles are almost all within the bubble film. I will perform that experiment if you like.

Q. 62. Well, I think you might as well do that.

A. I think we have the square jar machine here.

Q. 63. BY THE COURT: You say the particles are in the film of oil surrounding the air?

A. There will be a bubble film with air inside, and a surface with air outside. Now, the solid particles are completely within that film, and the film will raise up over the solid particles and, underneath, the film will come down under the solid particle, so that the particle

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is completely enclosed within the film, and there can be no question of the attachment of air for the particle itself. It is true that there is some selective attachment of air for sulphide particles as opposed to gangue particles, and in some of the earlier investigations of the subject it was thought that this actual attachment of the air for sulphide in preference to gangue was an explanation of the flotation process; but by examining these froths, it can be seen that air is not in contact with the solid particles at all as they come to the surface in the bubble film.

Q. 64. Could you illutsrate that with a little diagram, the position of the mineral particles in relation to the bubbles?

A. I can. If this particle is here as the small particle in the film, then one surface of the film will come along in this fashion and rise up over and surround the solid particle, while the other portion will come over in this fashion and then come down around the solid particle in that way (drawing). Now, after that film has stood for a short length of time, the condition presented will be something like this (drawing). The solid particle will stick out in such fashion as that. This film has already been raised to the surface; flotation has been done; all that remains is to scrape it off within a period of twenty or thirty seconds or a minute or so subsequent to this. This is the kind its of activity in the ordinary separation in the machine.

Q. 65. In referring to the face that was active in

the process, did you have reference to the upper or the lower drawing in the sketch?

A. To the upper drawing, the one that is numbered No. 1; and the second represents the condition after the bubble film has been some time at the surface.

Q. 66. Now, will you mark that diagram 5?

A. Diagram No. 5.

MR. SCOTT: I offer this diagram in evidence, No. 5.

Admitted without objection marked DEFENDANT'S EXHIBIT No. 128.

Q. 67. Does it require a fresh froth in order to see this?

A. Yes. I thought he had the square jar machine down here, but it seems he has not.

Q. 68. THE COURT: I do not understand what film that is; is that the oil coating of the air bubble?

A. Yes, that is the film around the bubble. The situation of the surface, if you consider this just a single bubble, will be something like this. Now, if I enlarge that particular film—

THE COURT: I think I understand now, Professor; I did not know for sure what you meant.

Q. 69. BY MR. WILLIAMS: Which is the outside of the bubble in your diagram; is it the top?

A. It does not make the least bit of difference.

Q. 70. BY MR. SCOTT: Referring to the circulating load in the flotation process, that is, the return of the middlings to the head of the machine, what is

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your opinion as to the condition of the oil that comes back with the middlings, that is, whether it is all adhering to and appropriated by mineral particles or not.

A. It is not, I think, all adhering to and appropriated by mineral particles.

Q. 71. What is your reason for so stating?

A. We are speaking now of the agitation froth process?

Q. 72. Yes.

A. In the later cells of the agitation froth machine, the froths are much more fragile, much less persistent than the froths in the earlier cells. Now, the persistence of the froth depends, of course, upon the load of solid matter contained in it. The less persistent froths, therefore, will have a smaller load of solids contained within them than the more persistent. It is the less persistent froths that are circulated. The bubble film itself consists of a complete lay~~o~~er on each surface, in which is concentrated oil, and the concentration lessens as you pass toward the center of the film. In other words, the whole area of the bubble film has oil upon it. If the solid particles do not occupy the whole area of the bubble film, then it must be true that between the solid particles there are areas of bubble film unoccupied by solids. But as the oil covers the whole area of the bubble film, then these areas which are unoccupied by solids are yet occupied by oil, and that oil is, of course, not appropriated by the solid matter, and is therefore unappropriated oil which is available for use in the circulating load as it comes back into the machine, for coating sulphide particles in the new feed.

Q. 73. How do you explain the fact which has been referred to that in flotation plants where heavy collecting oil is used in large bulk in connection with a lighter, so-called frothing oil, and the heavy collecting oil is discontinued, the froth has been observed to cease entirely?

A. The heavy collecting oil, so-called, is used in much greater quantities than the light, frothing oil; in other words, the amount of the light frothing oil added per ton of sulphide mineral present in the feed is extremely small; so small, in fact, that it would not coat enough air bubbles and collect enough solid matter to satisfy the requirements for the formation of a stable froth.

Q. 74. Instances have been referred to by witnesses in which the use of a large amount of oil made a more abundant froth than smaller quantities. Have you any explanation of that?

A. It is unquestionably the case in the agitation or in the beater cells, that a considerable number of air bubbles, under ordinary circumstances—particularly where small quantities of oil are used—pass through the process of agitation and on through the Spitzkasten without becoming coated with oil, and with solid particles. As the amount of the oil is increased, the number of chances and the probability of all the air bubbles becoming coated with oil, of course, increases, and the number of bubbles which do become coated with oil will increase according to these chances and probabilities. It is also true that in the ordinary agi-

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tation-froth process the bubbles—particularly in the first cells—are coated more heavily with solid particles than is absolutely essential to their persistence for the length of time required for their removal from the machine; so that there is present then sufficient sulphide to distribute over these additional oil bubbles that are formed when more oil is put in, and stabilized them, and thus increase the number of stable bubbles in the froth. In other words, increase its volume. I think that is the explanation of the increase in the volume of the froth with increasing oil.

Q. 75. It has been stated that the use of the oil referred to as Jones oil produces a very voluminous froth when used for the flotation of vanner tailings, but that this phenomenon is not observed when the same oil is used upon the low grade vanner concentrate. Can you explain that fact.

A. I have just stated that there was present in the froth of the first cell of the ordinary agitation-froth machine an excess of sulphide material above that required to stabilize the froth for the required length of time. The lessening of the amount of solid material in the froth means a lessening in viscosity of the bubble film while it may yet remain sufficiently viscous to be stable for the necessary length of time. However, as one of these lightly loaded bubbles comes to the surface the air contained within it of course tends to expand with the lessening of the pressure due to the decrease of hydrostatic head and the film will therefore expand as far as the viscosity will allow it. Vanner tailings

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are low grade, that is they contain a small per cent only of sulphide mineral. Consequently there will be a relatively small percentage of the stabilizing sulphide material present in the froth and the tendency of the bubble to expand as it reaches the surface is not overcome by the viscosity of the froth. The bubble will therefore expand and make the very voluminous froth that is complained of in this particular connection. On the other hand, in the vanner concentrate machine the feed is richer, contains a larger amount of sulphide. There is, therefore, a considerably larger load of sulphide present in each bubble. The degree of agitation being about the same, the viscosity of the film surrounding the bubble is so great, due to the greater amount of sulphide present in the film, as not to allow the bubble to expand under the decrease in pressure. Consequently you get the characteristic small-bubble heavy froth with these vanner concentrates and get away from the over frothing that is complained of with the Jones oil and vanner tailings.

Q. 76. Will you state whether or not it is essential, in your opinion, that the sulphide particles be coated with oil before leaving the emulsifier or before entering the flotation machine, in order that they may be emulsified in the bubble film?

A. It is not essential. In the beater cell we have present oil globules or air bubbles in numbers that are almost beyond comprehension, and while it is possible that a sulphide particle not yet oiled may not become oiled in the beater cell, yet it is extremely unlikely that

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any sulphide particle can miss meeting one of the oil bubbles or the oil globules in the beater cell when there are such enormous numbers present. It is a pure question of chance.

WHEREUPON an adjournment was taken until 2:00 P. M. Wednesday, April 25th, 1917.

2:00 o'clock P. M. April 25, 1917.

Q. 77. If you are ready now, professor, we will go ahead with the experiment of examining the bubbles under the microscope taken from the flotation froth.

A. All right, sir.

Q. 78. Describe first how the froth is to be made, and what of.

A. This experiment is intended to confirm the drawing which I made on the board, diagram 5, showing that the solid particles within the froth are, most of them,—almost all of them, included within the bubble film; by that I mean, not inside the bubble itself and in contact with the air inside, or outside the bubble and in contact with the air outside, but in contradistinction to that, entirely included within the film of the bubble itself, and not in contact with the air either on the inside of the bubble or on the outside of the bubble.

I hope to show that, by taking the froth on a ring and placing the ring under the microscope and examining first one side of the film, which will be stretched on the ring and which will be the outside of the bubble

as it appeared in the froth; then turning the ring over and examining the other side, which will represent the surface of the bubble which was toward the inside. The froth which is to be used will be made by mixing a charge as follows, in the Janney experimental machine: 400 grams of Butte & Superior ore; 2,000 c.c. of water at a temperature of 30° C.; 9/10 of a cubic centimeter of sulphuric acid of a specific gravity of 1.84; 1 c.c. of copper sulphate solution; 5.2 c.c. of oil mixture—of the particular mixture which is used in the Butte & Superior mill. That will be agitated, and in order that I may get a froth which is not so heavy as to be classed almost as a mud, I will skim off the first froth that comes up and get down to some of the later froths, where the particles are more widely separated in the film, and therefore more easily to be observed.

Q. 79. Professor, you might state to the court in a very few words how that Janney machine works. It has nothing to do with this experiment, but it is a convenient time to explain it.

A. The machine consists of a cylindrical portion, in which is a central shaft carrying two beaters, one about this point in the lower part and one at about this point in the upper part of the machine. At one side is the separating box in which the solution or pulp is much quieter, naturally, than it would be in the agitator. The separating box is connected with the cylinder at the bottom and at the upper portion. Surrounding this cylinder is this annular box, into which the froth is thrown by means of the beaters. The froth is

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then discharged onto the surface of the water in the separating box. The froth, of course, stays at the surface, so that the liquid containing the gangue, as the stuff is thrown out, settles and is drawn back in again through the opening at the bottom, thus having a circulation which, in some ways, is similar to the operation of the Janney machines which are used.

THE COURT: The court is assuming he is doing the thing he said he would, and these other gentlemen are watching. I don't know as it will add any to see him put in the material.

MR. WILLIAMS: I think it would be well to keep an open space between the eye of the court and the machine.

THE COURT: When it is operating.

THE WITNESS: (Gathering bubbles from the froth produced by the Janney machine.) Now, this has to be looked at rather rapidly. I think that will thin down. You see there is a bubble both this side and this side. Now, I have broken that so that I have both the inside and the outside of that bubble face as it stood. Now, if we can look at it under the microscope I think your honor will see that the film comes up and surrounds the large particles.

Q. 80. THE COURT: How many diameters is that?

A. Somewhere between 25 and 40. I haven't it exactly.

Q. 81. THE COURT: These protuberances that are bright, by reason of the reflection, those are what you term the mineral inside the film?

A. Yes, the film comes up over that. You will notice the film is raised up, a little mount above that. And I will show you the other side (turning the material over).

Q. 82. MR. WILLIAMS: Which side is that that is exposed?

A. I don't know. There is no difference between the sides.

Q. 83. MR. SCOTT: Will those particles project through the film if we leave it there five minutes or so?

A. They will if the film does not break before. If the film is sufficiently viscous to last. What I got there was a bubble somewhat like that with the wire coming right along the side of this and then I took my pencil and pricked one side of that so that I had the inside and the outside of the bubble.

Q. 84. MR. WILLIAMS: What you really have is a film of water containing mineral?

A. A film of water and oil, a film containing oil concentrated at the air surfaces.

Q. 85. Both surfaces?

A. Both surfaces, and in that film the solid material.

Q. 86. Where is the water?

A. The water is at the center of the film and the water is most highly concentrated at the center of the film, the oil most highly concentrated at the surface.

Q. 87. Now, I am looking at this through the microscope, and what I see is a few particles here and there that are metallic, and a great deal of material that is apparently gangue. Is that right?

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A. It might be. I would like to look and see whether I would check your observation. If you will qualify by saying apparently gangue, I will agree with you. I would not attempt to make the distinction between the rather light particles that are present and the gangue without more practice with the microscope on that particular ore.

Q. 88. Now, I can not see anything covering the metallic particles, can you?

A. I think if you will look now, Mr. Williams, that you will find that the surface of the film comes up over the larger particles in an entirely smooth and regular way, different from the irregular surface that would be presented if you saw the mineral itself.

Q. 89. I see nothing except bright metallic surfaces protruding upward.

A. Through the film?

Q. 90. I am unable to recognize the film. Can you tell me how to recognize it?

A. By its rather moist and somewhat liquid appearance, as opposed to the decidedly not-moist and decidedly not-liquid appearance of the solid matter.

Q. 91. Isn't it a fact that the metal particles are cleaned by this operation of terrific agitation to which they are subjected?

A. What do you mean by "cleaned"?

Q. 92. I mean polished, or the gangue removed from them?

A. No, sir.

Q. 93. You would expect to find dusty surfaces in that pulp?

A. Not dusty, no.

Q. 94. Wouldn't you expect to find clean surfaces of metal in that pulp?

A. Of the metallic particles, yes, but not particles that had been cleaned due to agitation, but rather due to the preliminary grinding that they had received.

Q. 95. And being cleaned, wouldn't they be bright?

A. They would, but they would not be liquid looking. They would not have the smooth and regularly curved surfaces, but would have angular surfaces. I think perhaps in order to show you the difference, I should take some of the original ore and put it in there and let you see the difference between the angular appearance of the dry ore and the smooth appearance of the liquid film.

Q. 96. In any event those metallic particles are to some extent coated with oil, are they not, as they exist in that bubble?

A. Unquestionably, sir.

Q. 97. And they would still be coated with oil if they were separate and apart from the bubble?

A. Unquestionably.

Q. 98. And that would make them glisten, wouldn't it?

A. Yes. They would not, however, I wish to state here, be in contact with the air if they were entirely coated with oil.

MR. WILLIAMS: That is all the cross-examination as to this particular experiment.

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DIRECT EXAMINATION (Resumed).

BY MR. SCOTT:

Q. 99. Professor Taggart, will you arrange in the microscope some of the dry ore that was used in this experiment, and if it is practical also expose some of the mineral particles out of the froth, covered by oil but separate from the bubble films, if that would be practical.

A. Yes.

Q. 100. Well, since you are not quite ready we will ask another question. Can you explain how it is possible that the amount of oil per ton of solids in a flotation system having a circulating load can be greater than the amount of oil initially fed into the machine per initial ton of feed?

A. I think I can explain that statement. It is not exactly accurate. There is present in the circulating load, naturally, no more oil than was originally fed in with the pulp; there is no device of course in the machine for the manufacture of oil. There is, however, this condition present, that the oil passes through the machine—the oil in the circulating load—at a rate considerably greater than the rate at which the original oil is fed in; or at least that is a possibility; it may be the other way. I think I can illustrate by a diagram just the distinction that I am trying to make between the amount of oil and the rate. If you consider this drawing to be the cylinder of a pump, this to be the piston and this the piston rod; S, the suction end of

the pump and D the discharge end of the pump, and that this is a pipe running around from the discharge end to the suction end; and if we assume that there is an opening in the top of that pipe, so as you could fill this whole system with oil, the pipe at this end of the cylinder (D).

Q. 101. You might indicate by letters as you go along.

A. The point for the introduction of the oil I will mark A; and if we introduce at A enough oil to completely fill the system, the pipe, the discharge end of the cylinder and as much of the suction end of the cylinder as is not taken up by the piston rod itself, and if we assume further that the total quantity of oil in there is, we will say, 25 gallons, now we start pumping, and the oil, of course, will circulate—in this fashion, around through the system. Now, if at any time we were to open this pipe and for a given length of time collect the oil that discharged—we will say for 30 seconds, and in that time we collected a gallon of oil—which is all within the realms of possibility—then we would have oil passing through that system at the rate of one gallon in thirty seconds, or 2,880 gallons per 24 hours, while you have only present in the complete system, 25 gallons of oil. It is a question of rate.

The same thing applies in the return system in the flotation process; there is present all the time an oil circulating, similarly to the oil circulating in this system. It is measured by cutting the stream of pulp for a given amount of time, by analyzing the pulp that is cut

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for oil, and by drying some of the pulp and weighing the solids in it. We have then the rate at which the oil is flowing through that system, and the amount of the solid that is flowing with the oil in the circulating system, so that there is cut from the middling charge in a second a given number of pounds of solids, accompanied by a given number of pounds of oil, which is the oil in the circulating system. If this is greater than the amount which is meant to be fed to the machine per ton of solid matter entering the machine, then it should be credited to the new oil which is necessary in order to bring the total amount of the oil entering the machine up to the desired proportion to the total amount of solids entering the machine. If the amount of oil is smaller than that fed in with the new feed, then new oil has got to be added in excess of that required by the new one. In order to furnish to the old pulp circulating through the machine enough oil to bring the oil in that pulp up to the amount that is put in with the new feed, and the total oil entering up to the proper proportion to the total amount of solids passing through the machine.

MR. SCOTT: I offer in evidence this diagram just referred to by the witness and being marked "Diagram 6 A. F. T."

Diagram admitted in evidence and marked DEFENDANT'S EXHIBIT No. 129.

THE WITNESS: (Producing a sample grain of ore and placing same under the microscope.) I think

that will show, Mr. Scott, the desired angular character of the particle and I think Mr. Williams may be able to see a difference between the rather angular particle there and the rounded surface of the film as it comes up under the original particle.

Q. 102. What have you placed under the microscope?

A. I have placed that portion of the ore which remains on a screen of approximately 80 meshes I think, yes, 80 meshes.

Q. 103. What is the nature of this ore you put on here now?

A. It consists of a large particle of solid material from this Butte & Superior ore which was used in the previous test.

Q. 104. This is some of the same ore that was in the froth?

A. No, but some of the same ore that was fed to the machine. I will take some of the ore in the froth later. You can notice the angular character of it. This is some of the material out of the froth. Note how much more angular that is.

Q. 105. MR. WILLIAMS: That is some of the concentrate you have just put into the microscope?

A. Yes, sir, that has been vanned out of the froth.

Q. 106. Why does it contain so much more of the gangue particles, large gangue particles than the one which you first showed?

A. I am sure I cannot say, sir. It was taken from a different part of the froth and furthermore the oil

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and the very fine particles which conceal what is in the froth have been removed here, making the presence of any large gangue particles much more easily discerned.

Q. 107. It is your understanding then that the free oil has been removed from this concentrate?

A. No, some oil unquestionably has. It would be very easy to prove that there was still oil present there.

Q. 108. But some oil has been removed from it?

A. Oh, unquestionably, yes.

Q. 109. MR. SCOTT: You referred this morning to the relation existing between the oil and the amount of sulphide mineral in the ore, between the amount of oil and the number of air bubbles or degree of aeration, and the third relation between the amount of oil and the dilution or the amount of water in the pulp. I wish you would state whether either of these three re-

P. 2991, L. 20, insert "ore or in comparing any two given ores or two given" after "given"

to trace absolutely the relation between the amount of oil necessary and any one of the three factors, aeration, dilution and percentage of sulphide. The method, of course, would be to keep all conditions standard except the one particular condition under investigation and then vary that amount. Under mill conditions the relation may be considerably harder to distinguish, because, except in most exceptional cases, the ore varies from day to day through, it may be, considerable limits in percentage of mineral content or in the percentage

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of dilution. It is possible of course in the mill to keep the degree of aeration constant but these two conditions of percentage of sulphide present and dilution will vary quite widely without the control of the ordinary operator in the mill. There will unquestionably, however, arise cases in which the relation between the amount of water and the amount of oil required or the amount of sulphide matter and the amount of oil required can be distinguished in mill operations. Some of the figures that have been presented by the men from the different mills to date indicate that they are confirming this opinion, and while I have not the definite figures at present at hand to confirm from these mill sheets, I think that that can be—could be studied out. The amount of oil that can be disposed of in the process, that is the range through which you can carry the oil with a given ore and under given conditions is rather large, and in my discussion this morning I tried to make it clear that I was speaking of the required amounts of oil to get certain conditions. That is, if with all our conditions constant, you had been working with a minimum quantity of oil to do the work and you increased the amount of sulphide in the feed, then in order to get satisfactory conditions it would be necessary to increase the amount of oil added; or in the case of the dilution, if, all other things being constant, you had been working with a minimum quantity of oil necessary to produce a certain result with a given dilution, and if you increased the dilution—that is the percentage of water—then it would be necessary to in-

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crease the amount of oil added in order to get the result that you had been obtaining before. And the same thing of course, in the case of aeration. It is true, moreover, that the condition has been presented by some of the previous witnesses that when they increased the quantity of oil that they added to the froth they decreased their agitation and they said that they did this in order to get good results. I think the explanation of that is that, not having varied the sulphide content and having more oil present, it was not necessary to do such a large amount of agitation in order to insure that the requisite amount of air bubbles for the collection of the sulphide material in the froth would be coated with a sufficient film of oil to serve their function. Consequently they decreased the amount of their agitation. And they further found that if they did not decrease the amount of agitatiion that they got what we may call over-frothing, that the froth overflowed the spitzkasten and ran all over the mill. I think the explanation of this is the fact that it is possible to stabilize the bubbles with a considerably smaller amount of solid material than is ordinarily the practice in the machine; that when they add the greater quantity of oil and thus coat a larger number of air bubbles, there having been some air bubbles coming through without an oil coating when the minimum amount of oil was used, the greater number of oil coated air bubbles each took up a smaller load of solid material, the load of solid material was sufficient to stabilize and consequently there was this increased number

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of air bubbles each with a sufficient load of solid material to stabilize it rising to the top of the spitzkasten and overflowing the spitzkasten. Therefore, they reduce the amount of agitation, reducing the number of air bubbles that were rising to the surface, loaded each one more heavily with sulphide material and thus reduced the over-frothing.

MR. SCOTT: You may cross-examine.

CROSS-EXAMINATION.

BY MR. WILLIAMS:

X-Q. 110. You have mentioned particularly experience in the mill of the Nevada Consolidated Mining Company at McGill, Nevada. How long ago was that?

A. 1910.

X-Q. 111. Did they use any flotation then?

A. No.

X-Q. 112. In what manner was the ore concentrated, generally?

A. Tables and vanners.

X-Q. 113. Water concentration?

A. Water concentration.

X-Q. 114. Were there slime losses?

A. Yes, sir.

X-Q. 115. Very considerable slime losses, were there not?

A. Quite considerable. I speak now with the viewpoint of an operator. I was not in a position of such authority there as to know the figures of recovery of the company.

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X-Q. 116. But they were constantly impounding slime tailings, weren't they, that were of considerable value?

A. That I couldn't say. They were passing the slime overflow through settling ponds, which would of course have the result of getting some of the contained values.

X-Q. 117. What kind of an ore did they have?

A. The ordinary so-called porphyry ore.

X-Q. 118. A lean copper ore?

A. Yes, with considerable iron sulphide present.

X-Q. 119. When did you last learn of their operations, from inspection?

A. In the fall of 1910.

X-Q. 120. So that you do not know that since then they have adopted flotation and are now getting very fine results?

A. Not of my personal knowledge.

X-Q. 121. And then the Montgomery Shoshone Mining Company. When were you there?

A. In 1908.

X-Q. 122. What kind of an ore?

A. Gold ore.

X-Q. 123. No flotation then I take it?

A. No.

X-Q. 124. When was your attention first called to flotation concentration of ores?

A. When the articles concerning it first began to appear in the mining periodicals.

X-Q. 125. About?

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A. I should presume that I became interested in that back along in 1912—probably 1911 or 1912.

X-Q. 126. Did you write or participate in the writing of an article which appeared in "Metallurgical and Chemical Engineering," volume 15, November 1, 1916?

A. I can't remember the particular date of its appearance. I think I can identify the article.

X-Q. 127. I show it to you?

A. Yes.

X-Q. 128. I read from that articles as follows: "The importance of flotation lies in the fact that it is primarily a "slimes process,' by means of which the particles of valuable mineral too fine for efficient gravity concentration are saved with a high percentage of recovery. Recovery in the mills treating low grade copper sulphide ore have been advanced ten to twenty per cent by the installation of the process and similar increased saving can be accomplished by the same means in mills treating sulphide ores of zinc and lead." That is a part of the article that you published and read before the American Institute of Mining Engineers in September, 1916?

A. It was presented before them. I did not read it.

X-Q. 129. And you accept those statements as true today?

A. To the best of my knowledge.

X-Q. 130. I read from that article as follows: "(1) That water has a smaller tendency to displace air on the surface of sulphide minerals than on the surface of gangue minerals; (2) that the tendency of oil to dis-

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place air is greater at the surface of sulphide minerals than at the surface of gangue minerals; (3) that oil tends to displace water on the surface of sulphide, and that water tends to displace oil at the surface of gangue minerals; (4) that water displaces air more readily on an oiled solid surface than on a clean surface of the same solid; (5) that these tendencies towards displacement are due to the interfacial tension or pressure existing between the various substances and that the resulting action of this interfacial force is a manifestation of the tendency towards reduction of the total potential energy of the system. Wherever an increase in the solid-fluid surface will decrease the potential energy, such a change will occur." You accept those as statements which you today will advance?

A. Yes.

X-Q. 131. And following in this article is a description of an experiment to demonstrate the fact that water tends to displace air more ~~rapidly~~ readily from an oiled metallic surface than from a non-oiled metallic surface. Will you accept that as a fair statement of what you demonstrated in the article?

A. Yes.

X-Q. 132. What is the difference between adsorption and absorption?

A. Absorption is the taking into the mass of a substance—some other substance, and as ordinarily used I think it is considered that the substance taken in by absorption passes through and diffuses through the mass of the absorbent. I ~~say~~ may use a homely illustration.

of a sponge placed in water; the sponge absorbs the water. Adsorption is the concentration at the surface between two phases—physical phases—of some substance which is a contaminant of one of the phases, under the rule that in a mixture of two substances, that the substance which will tend to reduce the surface tension of the system will tend to concentrate or adsorb at the contact of the sytsem with some other phase.

X-Q. 133. THE COURT: How does that apply to this question?

A. The question of flotation, when you have in the mass in the beater cells small globules of oil and small bubbles of air, when a particle of air and oil are brought closely enough together so that these forces which tend toward adsorption and which are rather small forces—can act, then the oil will spread itself over the entire surface of the air bubble within the pulp, because by so doing it can lower the surface tension of the pulp at the gas-liquid interface; the gas and the liquid being the two phases, and the oil the contaminant in the liquid, which tends to concentrate or adsorb at the interface between the two phases.

X-Q. 134. In testifying in regard to what you have called the agitation froth process, you have confined your description to the agitation in one vessel and separation of the froth in another as I understand it; is that right?

A. Yes.

X-Q. 135. You are aware, are you not, that the process is carried out with an agitator at the bottom

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of one vessel; air flowed in at the bottom of that vessel and the froth taken off at the top of the same vessel; that is known as sub-aeration; are you aware of that?

A. Yes, I have heard of it.

X-Q. 136. And then there is another variety, is there not, wherein there is no agitation in this vessel, but the air is broken up by flowing in underneath through a porous medium, and flows up, and the froth is taken off at the top?

A. Yes.

X-Q. 137. And referring to that, did you, in this article, state as follows:

"The principles involved in this method are the same as explained in the agitation-froth process. The only difference is in the method of introducing air. The result of this difference is that the bubbles in the pulp are much larger than in the agitation-froth method; they arrive at the surface less heavily loaded in proportion to their weight. The bubbles films are therefore less viscous and the froth less persistent."

A. Yes, sir.

X-Q. 138. Now, in the description that you have given of the bubble action in connection with the oiled mineral, I have not exactly understood what was the condition of the submerged bubble carrying the mineral or the sulphide particles attached to it, before its emergence above the surface of the liquid. Could you describe the condition of that bubble submerged ~~with the condition of that bubble submerged~~ with the metal particles or sulphide particles attached to it?

A. I think I can.

X-Q. 139. Please do so.

A. Of course that is something that is not capable, in the cell, of actual observation; but reason should lead to some such situation as this: (drawing) This represents a bubble in the mass of the pulp, and at some subsequent instant that bubble has met with a small globule of oil.

X-Q. 140. BY MR. SCOTT: Won't you please letter those points as you pass along?

A. Yes, I will do that. The bubble A, in the mass of the pulp B, having met a globule of oil, will become surrounded by a film of oil which is concentrated at the surface between the two phases, gas and liquid. The reason for such concentration is that by means of it the mass marked "B" can reduce its surface energy. The degree of concentration will vary from a maximum at the actual air surface to nothing or practically nothing at a distance away from it, and there will be present then, because that variation takes place through a very short distance—an interface or film, similar to the film or interface presented here between the oil and the water. The situation being on a much exaggerated scale, we might take the atmosphere of the room for the air of the bubbles, and the oil adsorbed at the air surface here and the water here, and here the point of varying concentration—or the place of varying concentration of the oil and water, from full concentration of the oil to full concentration of the water, being a very small distance.

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X-Q. 141. Will you say what you referred to in your answer; you did not describe it.

A. I refer to the red water and bubble experiment performed this morning. If we consider then, that this line (drawing) represents that interface, the line being marked C-D on my sketch, and at this side we have water and at this side oil, and if we consider, presented at that interface in some such fashion as that, a particle of sulphide mineral, and if we consider that that interface, the line C-D, is a fixed part of our system, and that the particle of solid matter is a moveable part of the system, then, due to the tendency of the oil to replace water at the surface of the sulphide particles, and due to the further fact that the line C-D here is fixed and can not move, then the sulphide particle itself must move, and the sulphide particle will move over into the oil. The reverse condition holds with the gangue particles. Here, assuming the line C-D or the plane represented by the line C-D, to be fixed, and the solid particle, the movable part of the system, then, due to the tendency of the water to replace the oil, in order to satisfy that tendency, the gangue particle must move into the water, and at that point you get the separation, so that you finally have then these particles of sulphide moving into the film—I will mark them "S"—moving in near to the air-liquid interface within the mass in the beater machine. I have marked this diagram No. 7.

MR. SCOTT: I offer this diagram which Prof. Taggart has marked No. 7 in evidence.

Diagram admitted in evidence without objection marked DEFENDANT'S EXHIBIT No. 130.

X-Q. 142. Now, Prof. Taggart, is there such an adsorption as you have spoken of at the oil-water phase—is there not an oil-water phase there, too?

A. Yes.

X-Q. 143. Is there an adsorption at that interface?

A. Adsorption of what?

X-Q. 144. That is what I would like you to tell me.

A. I don't know of any particular adsorption there that is of any importance in the particular discussion. It is probable—it is true that if there is present in either the oil or the water any contaminant which, by adsorbing or concentrating at the interface between the

P. 3002, L. 18, insert "that there will be adsorption of that particular contaminant at that interface," after "face"

and have any particular effect on the operation of the process.

X-Q. 145. Now, that layer of oil which surrounds the hole in the water that the air makes—

A. The hole in the pulp, you mean, do you not?

X-Q. 146. Yes, the hole in the pulp; that layer of oil is a definite layer, distinct from the water, is it?

A. I have indicated here a zone of transition from the highly concentrated oil to the highly concentrated water, and I have drawn the parallel here to the colored water-oil test; assuming this as a section on a very large scale of an air bubble of which the atmosphere of

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the room here forms the air. You see there concentrated at the air surface, due, I grant you here, to the force of gravity, a layer of oil, and there is a layer right at this surface between the oil and the water, through which the concentration varies regularly from a concentration of all or practically all oil, less and less and less oil to a concentration of practically all water. There is no actual discontinuity there, but the distance through which that variation in the concentration takes place is so small as to look like a sudden transition to the naked eye. Now, a similar transition takes place at the surface of the bubble in the pulp.

X-Q. 147. Would you call that an adsorption layer?

A. Unquestionably that would be an adsorption layer between the two liquid phases.

X-Q. 148. When the bubble is then immersed so that it is merely a hole in the pulp filled with air, would you say that it has a film about it?

A. I should think that would be a question of the definition of a film. Speaking accurately, I should not; I should say that it had about it a layer of oil which has this property that I have been repeating, of varying its concentration from the greatest concentration of oil at the air-liquid interface, gradually tailing off, decreasing until you get to a maximum concentration of the water at a distance from the bubble.

X-Q. 149. In talking of the oil as you have in the last few answers, have you reference to an insoluble substance?

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A. I presume you mean by insoluble the word as it is applied ordinarily to what are called insoluble oils as differentia~~l~~ed from the so-called soluble oil?

X-Q. 150. Well, take it that way and explain it.

A: I should say that the difference there is merely one of degree, and not of kind. That same thing would occur whether I were describing soluble oils here or the so-called insoluble oils; the difference being that the layer through which you pass from maximum concentration of oils to maximum concentration of water would be somewhat thicker, and bearing in mind that that change takes place through such a small distance here that it is practically impossible to distinguish it with the naked eye, you would still have the working condition about as presented in the previous discussion.

X-Q. 151. Well, let us take the case of a completely soluble modifying agent—frothing agent—dissolved in the water; what will happen then in the submerged air bubble?

A. Are you willing to further qualify your answer by stating that the oil or soluble modifying frothing agent will lower the surface tension of the pulp if it concentrates at the air-pulp contact?

X-Q. 152. As I understand it, that is a characteristic of all frothing agents, that they lower the surface tension.

A. I just wished that to appear in the question.

X-Q. 153. That is your understanding, is it not?

A. That is my understanding. If, then, that agent will lower the surface tension by adsorbing or concen-

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trating at the gas-liquid interface, it will so concentrate and adsorb.

X-Q. 154. Now, under such a condition, the dissolved frothing agent is normally distributed throughout the whole mass of water and pulp?

A. Yes.

X-Q. 155. You agitate so as to introduce air, or you introduce air by any other means, and you get a bubble in the pulp?

A. Yes.

X-Q. 156. Now, what kind and degree of concentration do you get around the wall or surface of that submerged bubble?

A. A sufficient concentration to lower the surface tension of the pulp at the gas-liquid interface.

X-Q. 157. Now, when the metallic particle meets that kind of a bubble, what happens?

A. The same thing exactly as happened in the case represented on the blackboard, provided that there is enough of this so-called soluble frothing agent there to coat the ore particles in the froth with a sufficient film of oil to allow of the selection of the gangue from the sulphide.

X-Q. 158. Now, in order to get away from oils, which you have rather interjected into your answers—suppose we take acetic acid as the soluble frothing agent, which reduces surface tension and produces, under the use of agitation and aeration, metalliferous froth—you know it does that?

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A. I have not done it experimentally, I will take your word for it.

X-Q. 159. Isn't it a known fact among students of this subject that acetic acid will do that?

A. I have heard of it, but I have not seen it.

X-Q. 160. Well, upon that assumption you can go ahead and tell me what will happen; describe the condition of the concentration or the condition.

A. The acetic acid in this particular instance plays the part which has been ascribed to the oil in the preceding discussion, provided that the acetic acid will lower the surface tension of the pulp, if it concentrates or adsorbs at the gas-liquid interface. I have not looked the figures up on that, nor have I made any experiments on it, so that my answer is based entirely on general reasoning, as concerns the process.

X-Q. 161. I unfortunately selected a soluble frothing agent with the action of which you were not familiar. What soluble frothing agents have you operated with and are you familiar with?

A. I am not particularly familiar with the action of any of the so-called soluble frothing agents as opposed to the so-called insoluble frothing agents, Mr. Williams. My work to date has been most largely attempting to construct a theory and reconcile with that theory observed facts, and it has not yet extended to the point where I feel myself qualified to state from definite experimental data anything in regard to any such difference as I presume you are attempting to indicate.

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X-Q. 162. Phenol and cresol you know they are soluble frothing agents?

A. Yes.

X-Q. 163. And you know that they are present in wood tar oil?

A. Yes.

X-Q. 164. And coal tar oils?

A. Yes, I do. I know that from reading; not from analysis.

X-Q. 165. Is your knowledge such that you can give me any figures as to the actual concentration that would take place at the surface of an immersed air bubble in the presence of any dissolved frothing agent?

A. No, sir.

X-Q. 166. You do not know as a fact that the ratio of concentration is less than one millionth?

A. No, sir.

X-Q. 167. You don't know that?

A. No, sir.

X-Q. 168. Now, in the presence of a soluble frothing agent what happens to the metallic particle before it meets an air bubble?

A. It probably has adsorbed or concentrated at its surface some of the soluble frothing agent.

X-Q. 169. You put that forth, of course, as a theory?

A. As a theory.

X-Q. 170. And when that metallic particle meets an air bubble, just what happens?

A. I should expect that some of the soluble frothing agents which had been adsorbed at its surface would adsorb at the air-liquid contact.

X-Q. 171. Then what happens to the metallic particle?

A. If the degree of adsorption at the air-liquid contact is sufficient so that the condition that I have represented in my diagram 7 obtains, then the sulphide particle will pass into the layer of higher degree of concentration of the so-called soluble frothing agent and be carried to the surface with the bubble.

X-Q. 172. And what holds it there in the rush and swirl of the pulp while being agitated?

A. This surface force of adsorption and the fact in that in that particular condition in the pulp the sulphide particle represents the condition of least possible potential energy of the mixture of sulphide particle, soluble frothing agent and concentrate at the surface of the bubble and water.

X-Q. 173. What happens to that bubble when it commences to emerge from the pulp?

A. Some of the soluble frothing agent—I suppose you are still talking of these so-called frothing agents?

X-Q. 174. Yes, the same ones.

A. Adsorb at the new air surface that is formed because by so adsorbing and by so concentrating it can reduce the energy of the system formed of soluble frothing agents, water and gas.

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X-Q. 175. And then as that bubble r~~a~~ises up out of the pulp what happens?

A. This process continues as the bubble emerges into the air, at the air surface there is a concentrated layer of the so-called soluble frothing agent, the concentration passing off toward the interior of the film and at the center of the film the concentration of the so-called soluble frothing agent is ~~last~~ least and the concentration of water is greatest. From that point ~~once~~ on the concentration of the so-called frothing agent increases until at the other gas surface the concentration is again a maximum.

X-Q. 176. That is to say, at the outside of the bubble you have a maximum concentration; at the inside wall of the bubble or the inside of the film of the bubble you have a maximum concentration and passing through the thickness of that wall, however thin it may be, you pass through these stages of maximum, minimum maximum? Is that right?

A. Yes, sir.

X-Q. 177. And where is the mineral, the metalliferous mineral product?

A. The mineral is wholly within the bubble, ~~the~~ film.

X-Q. 178. That is given as a theory?

A. No, that is an observed fact.

X-Q. 179. An observed fact as you showed it to me?

A. Yes, sir.

X-Q. 180. But I could not observe it.

A. Perhaps you are not accustomed to working through a microscope.

X-Q. 181. Now you have showed it to me with an oil?

A. Yes, sir.

X-Q. 182. And that oil was, so far as we saw it there, insoluble oil, was it not?

A. Insoluble?

X-Q. 183. An insoluble oil, an oil that ha~~s~~d not been dissolved?

A. I should not attempt to so define it from my observation.

X-Q. 184. Was that oil partly dissolved, that we saw under the microscope?

A. I think unquestionably so.

X-Q. 185. Partially dissolved and partially undissolved.

A. I think unquestionably so.

X-Q. 186. What kind of an oil did you use in that experiment?

A. In this particular case?

X-Q. 187. In the particular experiment that you showed me?

A. I would have to ask somebody from the Butte & Superior to say as to the oil. The phenomenon to be observed is the same with any oil so I didn't pay any particular attention to the oil that was used. If you care—would you like—

MR. WILLIAMS: I will take the statement of whoever put the oil in.

MR. SCOTT: Mr. Dosenbach.

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MR. DOSENBACH: The oil was mixture consisting of 70% fuel oil, 18% pine oil and 12% kerosene.

X-Q. 188. MR. WILLIAMS: Endeavoring to put the matter in language not scientific, perhaps, but more understandable to the lay mind: When you have oil, in the flotation process, the oil coats the metal, doesn't it, in the pulp?

A. I think that some of it, some of the metal in the pulp is coated. As I say that question of coating the metal in the pulp is purely a question—I presume you mean before the metal comes in contact with an oil coated bubble?

X-Q. 189. We will take that?

A. That is purely a question of chance. You have got a certain number of globules of oil in the pulp, emulsified there, an enormous number, millions or even billions would be needed to express the number. Also if I recollect correctly, a cubic inch of a sulphide subdivided into the size of the ordinary flotation process breaks up into something like three hundred million particles. Now, in a mixture containing millions of oil globules and millions of sulphide particles, the number of probable combinations of the oil globules and solid particles is of course enormous, and there are therefore an enormous number of chances for an oil particle and a sulphide particle to come together. If they do so come together the oil would tend to absorb at the sulphide surface by replacing the water. If, however, one of these particles should miss meeting an oil globule of course it would miss being coated.

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X-Q. 190. Now, turning to your diagram 7 and to the line that you have indicated CD. In the case of a soluble frothing agent, a frothing agent wholly in solution, to the right of that picture would be water containing soluble frothing agent dissolved in it, wouldn't it?

A. Yes.

X-Q. 191. What would be to the left of that picture where you now have oil?

A. The concentration of the soluble frothing agent to the left, and you will recollect that my line CD represented a line somewhere around in here surrounding the bubble, so that there is the so-called oil to the left of this line and the water at the right. The concentration of the so-called soluble frothing agent will increase as the air-liquid interface is approached.

X-Q. 192. And the upper of your particles marked "Sulphide" will be where with the soluble frothing agent?

A. There. And in the same position that they are are marked there.

X-Q. 193. And the thing that shields that metal particle from the air inside the bubble will be where?

A. This. The interface between the air and the liquid, and at that interface the oil will be most wholly—or the frothing agent will be most wholly concentrated.

X-Q. 194. And you present that theory without having any knowledge of the amount of concentration that takes place?

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A. Yes, sir.

X-Q. 195. And as to whether it may be a wholly negligible factor?

A. Well, it is not a wholly negligible factor.

X-Q. 196. You accept the term "selective action"?

A. As meaning what?

X-Q. 197. Oils and metals in the ore pulp.

A. As meaning that the oil has a tendency to replace the water at the surface of the sulphide particle and that the water has a tendency to replace the oil at the surface of the gangue particle, yes, sir.

X-Q. 198. Now, suppose we have a pulp in which acetic acid is dissolved?

A. Yes, sir.

X-Q. 199. Has acetic acid that same selectiv~~ely~~ity for metal?

A. It must have if the sulphide particle concentrates at the surface of the air bubble in a way entirely similar to the way in which it concentrates at the surface of the air bubble when oil is used as the contaminant rather than acetic acid.

X-Q. 200. And how about the gangue?

A. The same statement must apply.

X-Q. 201. That is to say, the acetic acid solution selects the metalliferous mineral for concentration at its surface and does not do so as to the gangue?

A. Whatever a~~b~~dsorbs at the liquid-gas interface, when acetic acid is used as the contaminant, forms there a film which acts with respect to the sulphide in a way entirely similar to the way in which the oil acts

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when oil is used if, as I say, the sulphide concentrates at this gas-liquid interface.

X-Q. 202. Take such a substance as saponine in solution in water. Will that reduce the surface tension?

A. I do not know.

X-Q. 203. Will that adsorb at the surface of the metal?

A. I do not know.

X-Q. 204. Where, in your theory, is the selective action of air for metal utilized?

A. It is not utilized.

X-Q. 205. Discarded—You discard it?

A. Yes, sir.

X-Q. 206. Wholly?

A. Yes, sir.

X-Q. 207. Take soap, for example. That dissolves in water. That reduces surface tension, does it not?

A. Yes, sir.

X-Q. 208. Does that adsorb at the surface of a mineral when thus dissolved.

A. I do not know. It is not necessary that everything which reduces the surface tension of a liquid and thus adsorbs at the surface and aids in stabilizing a froth will also select a sulphide mineral from a gangue.

X-Q. 209. Why not?

A. I do not know. These are experimental facts, that there are certain substances which so adsorb at gas-liquid surfaces will select sulphide mineral from gangue.

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X-Q. 210. And are both these conditions necessary for froth flotation?

A. First that the—no, it is not necessary that the particle which selects shall also reduce the surface tension.

X-Q. 211. But is it necessary that there should be something to select and something to reduce the surface tension?

A. No. There should be something to select.

X-Q. 212. Well, what do you mean by that?

A. That there should be present something which will adsorb, or which will cause adsorption at the surface of some substance which will have a selective action for the sulphide as opposed to its selective action for gangue.

X-Q. 213. Isn't air such a substance?

P. 3015, After L. 19, insert "A. I don't know that from my own investigation."

A. I have seen the operation at the Butte & Superior Mining Company's mill and at the mill of the Utah Copper Company.

X-Q. 216. During what period?

A. Recently, since I have come to Butte.

X-Q. 217. Since the first of the year?

A. Yes, sir, since I have come to Butte.

X-Q. 218. And all these operations that you observed were with what general proportions of oil?

A. I do not know. I do not know at Butte & Su-

perior. I do not know what all the operations were at the Utah Copper. Some of them I know and some of them I do not. They were more or less varied.

X-Q. 219. I suppose you would not be able to recognize the difference between large and small quantities of oil?

A. That depends upon how large and how small.

X-Q. 220. Well, take below twenty pounds and above twenty pounds—take four pounds of oil to the ton of ore and then 22 pounds of oil to the ton of ore. You would recognize the difference at once wouldn't you?

A. I can't say, Mr. Williams, because my experience with these operations has been, as you see from my answer to the last question, rather small and I would not say. If you will say 200 pounds or 250 pounds, yes; I can tell that without any question.

X-Q. 221. Well, suppose we take an operation with two pounds of oil to the ton of ore, one tenth of one per cent. As I understand your theory the oil carries the mineral in the froth, is that right?

A. The froth carries the mineral; and the froth consists of oil and water and air.

X-Q. 222. Mighty little oil there, isn't there?

A. Yes. The bubble film, I should perhaps say.

X-Q. 223. Have you ever seen the concentrates that come from an operation of two pounds of oil to the ton or less?

A. Not that I know of.

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X-Q. 224. You are not aware of the fact that the oil has disappeared from sight and touch?

A. No, sir.

X-Q. 225. Now, when you announced three conditions which determine the amount of oil, the amount of the sulphide mineral, the amount of aeration and the dilution of the pulp, did you base that upon a study of recent operations such as you have described?

A. No, sir; that was based purely on reasoning, and, as I think I stated previously, some outside confirmation in mill practice, in the figures presented previously. I have not yet had time to go through those sufficiently thoroughly to make that an absolute statement, but the figures tend in that direction. It is very hard, as I think I said before, to sort such conditions out in mill practice, due to the fact that one of two conditions, or two of them, may be operating at the same time, and it is hard to segregate one from the other; but in such cases where two of the conditions do remain constant over any period, then the third is very plainly the determining factor in the amount of oil necessary.

X-Q. 226. As a matter of fact you put those forward as theories which seem reasonable to you?

A. No, I put them forward as explanations—as predictions of what must occur, from observation of other observed phenomena.

X-Q. 227. But they have not been subjected to the acid test of study of those conditions in the manner in

which they should be studied before you could put them forward as rules?

A. Carrying all things constant and varying one of them, you mean?

X-Q. 228. Yes.

A. No, I have not.

X-Q. 229. You said in one of your answers that acid in the froth flotation process tends to adsorb at the gangue particles.

A. At the surface of the gangue particles.

X-Q. 230. Did you refer to any particular acid?

A. Sulphuric acid. That is the one principally used.

X-Q. 231. Does that imply that there is a reduction of surface tension by reason of that adsorption?

A. No.

X-Q. 232. Does sulphuric acid when dissolved in water, increase or diminish the surface tension of the water?

A. I believe that it increases it.

X-Q. 233. That is a well known scientific fact, is it not?

A. I have seen it stated recently in some books; I looked it up particularly in anticipation of the question.

X-Q. 234. The Chemical Calendar gives that, doesn't it?

A. Yes, I think so.

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X-Q. 235. A rather remarkable fact, that sulphuric acid, when dissolved in water, increases the surface tension of water, making it a rather unusual substance in that particular, isn't that the fact?

A. I did not read that.

X-Q. 236. Isn't it a fact?

A. I don't know as to that.

X-Q. 237. Now, in your article, of which I read portions to you; in case No. 2, sulphide gangue, water, oil and acid. You say "The addition of the acid has the two-fold effect of further lowering the surface tension and decreasing the adhesion ratio." That is true, is it not?

A. True reading, yes. I have learned more since that was written.

X-Q. 238. That was a mistake?

A. That was a mistake. It will be noticed, I think, if you look at the paper that the lowering of the surface tension by the acid—if you will recollect the experiment here, the question of lowering of the surface tension has not been emphasized as the important factor in the stabilizing of the froth.

THE COURT: I suppose your science is like law, always something to learn?

A. Yes, exactly, and this is rather a new branch.

X-Q. 239. MR. WILLIAMS: How would you popularly define this viscosity?

A. I think, as the resistence of two adjacent parts, both liquid, to the movement of one part past the other.

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X-Q. 240. Would tenacity be suggestive of the quality of viscosity?

A. Well, I should think that viscosity with that definition would be a sufficiently definite term to use.

X-Q. 241. Would you accept "tenacity" as somewhat illustrative of the qua~~nt~~lity of viscosity?

A. No, I would much rather use viscosity. Tenacity has an entirely different meaning.

X-Q. 242. Do you know the methods that are used or that are perhaps the most usual methods used to measure viscosity?

A. No, sir; I think that one of the subsequent witnesses can probably give you the physical methods.

RE-DIRECT EXAMINATION,

BY MR. SCOTT:

R-Q. 243. Do you know of any instance, Prof. Taggart, in which a substance which has the effect of raising the surface tension of water understood to produce froth flotation and concentration?

A. In the Potter-Delprat process, which consists in the introduction into a pulp, finely ground, of hot sulphuric acid, and a stirring of that pulp, there arises to the surface and forms on the surface a froth, which, looked at under the microscope, is similar in appearance to the froth which I showed this afternoon; that is, it consists of a liquid film generally within which are the particles of sulphide, and as far as I have been

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able to see, those particles are contained as wholly within the film as the particles in this film that we had here. Sulphuric acid raises the surface tension, and we get conditions that are entirely similar to the conditions to the process using oil. The question, however, will come entirely under the general presentation, that there is some substance present within the contaminated mass which by absorbing or concentrating at the surface—at the liquid-air surface, lowers the surface tension, and which has the further quality of selecting the sulphide from the gangue. The bubbles then rise to the surface and notwithstanding the fact that these bubbles may have a somewhat higher surface tension than that of water, there is, nevertheless, due to the selective action of whatever the film is at the surface of the bubble, that the sulphide particles —There is present a film of solid matter which is sufficient to stabilize that mass long enough to allow the froth to be removed from the machine.

R-Q. 244. Can you draw any inference regarding the relative importance of the powdered ore ~~and the powdered~~ ore and the liquid frothing agent as a stabilizing substance from the fact that this Potter Delprat process can be carried out, notwithstanding the raising of the surface tension of the water by the reagent used?

A. It is my opinion that the stabilizing by means of the solid matter is by far the most important part of the process of stabilizing. I think that was

well represented in the experiment this morning in which you saw that with plain water, at the water-air interface, the solid matter stabilized the film and made it act approximately as a solid, while at the air-liquid surface, when the solid matter was absent, and yet some of the soluble agent was present, there was no such stiffening of the film as to cause the surface to act approximately as a solid.

R-Q. 245. Could you tell a bubble film of the Potter process from one formed with oil, by examining them under the microscope?

A. Not if the oil was used in very small quantities. As you increase the quantity of the oil, of course it becomes more visible in the bubble films, and then you could; but I used in the particular experiment to which I referred, a galena-limestone ore from Joplin, Missouri, some small quantity of blende being present, and in that particular ore—working on the Potter-Delprat process, and working with a small quantity of oil, as limited a quantity as I could use and still get froth, and I did not measure the exact quantities—Then I could not tell the difference between the froths. It is not true that I had them presented to me, one and the other, without my knowledge as to which they were and attempted to tell the difference; but with the knowledge of the facts before me I could not distinguish any difference.

R-Q. 246. If the oil were used in something above the minimum quantities, would it be by reason of any

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difference in the structure between the oil formed froth and the Potter froth that you would distinguish them, or merely by your ability to see the oil as oil?

A. I think merely by my ability to see the oil and see the possible play of colors at the bubble surface, due to oil contamination.

R-Q. 247. As far as the structure of the film and the nature of the film goes, would there be any difference between the two, even though a large amount of oil were used?

A. No difference in character; merely the difference in the thickness of the oil layer.

R-Q. 248. I think this morning you stated, and also this afternoon, that it is not essential to this process that the sulphide particles be coated with oil; that they are very likely to become coated with oil, but that it is not essential, and you stated that—I am not sure whether you stated that it was not necessary to pre-agitate before sending the pulp to the Spitzkasten or to the machine provided with the Spitzkasten; but in view of that statement I will ask you why it is that they usually agitate it before sending it to the Spitzkasten?

A. I think there are two reasons probably. If you do not preagitate, then you do not get the emulsification previous to the passage of some of the pulp into the Spitzkasten—That is, you do not get as great pre-agitation as where you use a couple of preliminary agitators before the separating process. The re-

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sult of the lack of such pre-agitation is that some of the oil in the pulp, which has not yet been taken up by bubble surfaces, floats and is therefore lost to the process; and furthermore, to get as complete aeration and give as good a chance for the sulphide particles to pass into the froth, were you not using this preliminary agitation, it would be necessary to add one or more Spitzkasten and agitators to the regular flotation machine. There are those two things, and probably the ~~most~~ more important factor is the one of conserving the oil,—not wasting it on the surface of the first Spitzkasten.

RE-CROSS EXAMINATION,

BY MR. WILLIAMS:

RX-Q. 249. I don't think that you have described the oil bubble carrying metal particles as it is above the surface of the liquid.

A. I attempted to, sir; I said that we had at the interior of the bubbles, air; surrounding that a liquid film, composed, in the case of the oil bubble, of oil and water; that at the air-liquid contact—and I speak here of the air within the bubble—there is a concentration of the oil—a high concentration of the oil, and as you pass toward the center of the film the degree of the concentration of the oil lessens and the degree of concentration of the water increases, until at the center of the film the water is at its maximum concentration. Passing from that point outward, the degree of concentration of the water lessens and the

degree of concentration of the oil increases to the outer air-liquid interface, where the oil concentration is again a maximum.

RE-RE-DIRECT EXAMINATION,

BY MR. SCOTT:

R-Q. 250. One more question. Have you made such a study of the Potter-Delprat process as would enable you to advance an explanation of those processes corresponding to the explanation that you have given of the oil process today?

A. Well, I should say that the explanation was absolutely the same, except that I do not know what the particular thing is which concentrates at the air-liquid contact, and which has a selective action for sulphide mineral as opposed to the gangue. We suspected, when we first started, that that thing was a case of gas attachment to the particles, and we were very much surprised and rather dumbfounded at first when we examined the films under the microscope and found that they were, in as far as we were able to distinguish, the same films that we had been obtaining by the use of oil—in appearance.

R-Q. 251. You have never ascertained, then, what it is which brings about this selective action?

A. Not apart from the fact that the system tends to arrange itself—and this is of course good physics—in such an order as to present the least energy—as to have the least potential energy.

RE-RE-CROSS EXAMINATION,

BY MR. WILLIAMS:

RX-Q. 252. Are you sufficiently familiar with the history of the subject to know that the Potter process won't work with slimes?

A. No, sir.

WITNESS EXCUSED.

PROFESSOR FREDERICK E. BEACH, a witness called on behalf of the defendant being first duly sworn testified as follows:

DIRECT EXAMINATION,

BY MR. SCOTT:

Q. 1. Please state your full name.

A. Frederick E. Beach.

Q. 2. Will you please state your qualifications for testifying upon the subject now before the court?

A. Well, I was educated at Yale University, and my undergraduate course was as a student of mechanical engineering. After graduation I spent four years, part of the time as an apprentice and part of the time as a journeyman machinist, and then for a few years I was a draftsman, and after that I returned to Yale University as a graduate student, and after three years' study received a degree of Doctor of

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Philosophy, and since that time I have taught there, and my present position and title is Assistant Professor of Physics in Yale University. My teaching has been, with very slight exception, in the department of the university known as the Sheffield Scientific School; that is, the scientific department of the university as compared to the classical department.

Q. 3. About how many years has your connection with Yale University as an instructor or professor covered?

A. As I remember it, I have had charge of classroom instruction—not as a mere laboratory assistant, but as a classroom instruct~~ion~~or, since 1891.

Q. 4. I presume considerable of your time is given to research, as well as instruction?

A. No, not a great deal; my occupation has been more particularly with the teaching functions than with research.

Q. 5. Have you any connection with mining operations or mining interests?

A. No; personally, none.

Q. 6. How did it happen that you became interested in this flotation concentration process?

A. Well, it was a matter of conference between the different departments. The staff—the Faculty of the Hammond Mining Laboratory, that is, the so-called mining department of the university, had this problem there, to teach flotation, and flotation processes of mineral separation; and as no accepted explanation

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had been given, and it was regarded as more or less of a mystery, a request was sent over to the Physics Department, the Sloan Physics Laboratory, for some collaboration on a work of investigation to see if we could find out what the explanation for this particular phenomenon was.

Q. 7. Did you make some progress in that investigation?

A. Why, yes; after studying it for a number of months—I don't recall just how long, but 6 or 8 months—we felt satisfied that we had a true and satisfactory explanation.

Q. 8. Can you summarize the points in the theory you arrived at?

A. Well, stated in a very popular way, it might be something like this: To take examples of familiar separation: Suppose, for example, that you had particles of finely divided gold held more or less in suspension in water. Now, it is known that mercury—quicksilver—has a selective action on gold; it is popularly said that mercury wets gold. As a matter of fact, gold is soluble in mercury, forming what is called an amalgam. So that, to make a sort of hypothetical separation process, imagine that we had a lot of small mercury particles falling down through a pulp consisting of water and suspended gold particles; as these mercury globules touched these gold particles, the gold would stick to the mercury and would be carried down to the bottom. Of course there is not any such actual

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process carried out; the actual selection of the gold particles by mercury is carried out in a different way practically, in the amalgamation process.

Now, to continue our imaginary picture, suppose that these little globules of mercury were blown full of air, so that they were mercury bubbles, and suppose that they were let in at the bottom of the vessel, ~~were~~ they would rise up through the mass, the little sheets of mercury on the outside of this bubble coming in contact with the gold particles would carry them up. We should have the elevation of the gold amalgam to the top of the surface. That is a picture that we could have in our mind of how we could separate gold by the aid of the selective action of mercury.

Now, we have a somewhat similar case in regard to sulphides and oils. It is known—I think it is acknowledged by everyone—that oil wets sulphides—and when I say sulphides I mean in general, metallic ores, or ores having metallic lustres; I do not specify sulphide as a particular case—Oil wets sulphides, and the sulphides adhere to the drops of oil. Suppose we took an amount of dense oil and let it fall down through a pulp, which is water containing a lot of sulphide particles in suspension, and that these drops of oil were heavy enough—I mean if the density of the oil were near enough to unity, or a little more than unity—as they dropped into the water surface they would fall a certain distance, and as they fell down, if they came in contact with any particles of

sulphide they would carry them down to the bottom of the vessel, provided the density of the oil was greater than the density of the water. This is the analogy of the mercury drops carrying the gold down.

Now, to reverse the case, suppose we take out the interior of the little drop~~s~~ and fill it with air so that it is a kind of balloon except that the envelope of the balloon is oil or an oily film, and allow these oily balloons, so to speak, to rise up through this pulp to the surface. The sulphide would be above the surface, it would be elevated by these little balloons to which they stick. Now, that is the mental picture that we formed of what actually happened in the flotation cell, after we had examined the process. Of course that does not account for all the details. I have it in mind a little bit later to point out the accepted scientific principles which bring all the processes of the flotation cell into harmony with the accepted facts or principles of physics. That is just a preliminary sketch of our idea of how flotation occurs.

Q. 9. Would it be in line with your plan of explaining this to state the particular principles or facts that you established?

A. In order to explain how this thing comes out or occurs it would be necessary to establish on an experimental basis certain facts: first, the fact of the selective adhesion of oil to a metallic or sulphide particle; second, it would be necessary to establish the existence and variation of surface tension; thirdly, we

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ought to establish the fact or the essential condition for a standard bubble film. These are essentially experimental facts. Now, fourth, we will make use of what is called the principle of minimum potential energy. The potential energy of a system tends to a minimum. In order to have a satisfactory explanation which would be accepted by the scientific world, these facts must be established. The principle, I suppose, is not subject to question.

Q. 10. How do you proceed to demonstrate the selective adhesion of different liquids for a solid? And, if I might make a suggestion, if it occurs to you as we go along, I suggest that you make use of the simple experiment that we started with, whenever an analogy occurs, I think it would help us; that is to refer back to the mercury bubble or the oil bubble whenever occasion arises.

A. Well, we are presented first with the question: Do different substances behave differently toward each other? Does one liquid wet a substance more than another liquid? And is there any way of making this quantitative? That is, I mean is there any way of saying that one liquid wets another twice as much as the first? That is the first problem that presents itself to me. In the flotation cell there is evidently some difference in the action of the liquids involved on the sulphide than that on the quartz. Now, can we exhibit or demonstrate in any way, apart from engineering processes, commercial processes, the fact

that these liquids do behave differently with respect to these substances? Will one—we will resort to some very simple experiment. Take a perfectly clean plate of glass and put on it a drop of essentially pure water. Instead of this drop standing in a heap, it will flatten itself out and spread for a very considerable distance from the point which was initially touched. Now suppose you take the same water or a drop from the same sample of water and put it on the leaf of a familiar vegetable, cabbage, it will be observed there that this drop does not seem to spread out. In popular language without any attempt to make this a quantitative statement, one might say that water wets glass but does not wet the waxy vegetable surface. That, however, is not quite satisfactory to the physicist. He wants to know: How much does the water wet the glass? Twice as much as it does the cabbage leaf? Or is it 100 times as much? I do not know of any book in which that answer has been provided. Another familiar example of the selective action or a selective adhesion of liquid for solids can be seen in the case of mercury. If a drop of mercury is placed on the surface of glass, if the drop is relatively small, it will gather itself together in a globular form. If a drop of mercury is put on a gold watch case, the mercury will flatten itself out and spread over very much as the water did on the glass surface. There is evidently some intimate and essential difference in the behavior ~~heavier~~ of substances with respect to each other. In

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popular language it is said that mercury wets gold but mercury does not wet glass. That is not very satisfactory. In fact it is not altogether true and if the court would permit me I would like to show a simple experiment which will—I mean I would like to draw a figure to illustrate a simple experiment which I have often tried before classes to indicate that mercury does wet glass. It is simply a question of degree and not a question of difference in kind. Suppose that represents a horizontal surface of glass and you take—

Q. 11. (Interrupting.) Professor, might I suggest that as you go along you letter everything so that when we have it here we can follow your illustration?

A. "G" represents a horizontal glass surface. And if we put upon that a drop of mercury ("M") that mercury will ultimately assume a shape something like that (indicating). I intended that the upper surface should be level. The thing to which I wish to draw attention is that at the point which appears to be the point of contact of the mercury with the glass, the tangent of that curve makes an angle between the glass and the tangent of roughly something like 135 degrees. I do not mean to say that it is always that, but it looks something like that. This angle on this side might be 45°. Now, suppose we vary our experiment indicating the contact of mercury and glass in this way. Suppose we take a tube and on the end

of that tube we blow a little glass bubble or sphere (S). "T" represents the tube of glass; "S" the sphere which has been blown at the end of it. We will assume we make use of the convex surface of glass. Now, suppose we lower that down until it touches a horizontal surface of mercury. "H" is the horizontal surface of the pool of mercury (M). Externally it will be observed that this mercury surface is not level, as we get very close up to this sphere, but that it will rise above the hydrostatic level of the mercury, and we shall have the condition of things which was really present here, namely, that the angle between the tangent, the liquid surface and the tangent, the glass surface is again something like 135°. That is to say, the same condition of things occurs there as occurs here. But when you look at this diagram with the mercury rising up to meet the glass you will be convinced—when you look at that I say you will be convinced that mercury does wet glass. It sticks to it, adheres to it. Otherwise, it would not rise above its horizontal level. So, it is not true to say in such broad language that mercury does not wet glass. It is simply a question of degree, how much it wets it. Now, that is the first problem that is presented to us to find out how much these different liquids, oil, water, alcohol, acetic acid, other things, wet sulphide compared to the amount which they wet quartz or calcite or other gangue materials.

Q. 12. Before we forget it I would like you to

mark the diagram. You might mark it diagram No. 8 with your initials.

(Witness marks diagram.)

MR. SCOTT: We offer this diagram in evidence.

MR. WILLIAMS: No objection.

Diagram admitted in evidence and marked DEFENDANT'S EXHIBIT 131.

WHEREUPON an adjournment was taken until 10:00 A. M. Thursday, April 26th, 1917.

Thursday, April 26th, 1917.

FREDERICK E. BEACH resumed the stand for further

DIRECT EXAMINATION

BY MR. SHERIDAN:

MR. SHERIDAN: If the court please, I would like to make a request this morning. We have some lantern slides of those pictures showing the different forms of bubbles and different froths with different varieties and kinds of oils. Now, it is not going to be very agreeable to show these in the daytime, either to the court or counsel; and if the court will give us an evening session, any evening, beginning, say at eight o'clock, it will probably take an hour and a quarter to an hour and a half to show them. I think it will be very instructive. A photograph looks flat while

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a lantern projection will look very clear. We want to offer them in evidence, but we would like to show them as we offer them.

THE COURT: What are these?

MR. SHERIDAN: Lantern slides of those photographs you saw. We have the lantern and the slides. Any evening that will suit the court and counsel.

THE COURT: All right, some evening before you get through.

MR. SHERIDAN: Most any evening. We can make it tonight or tomorrow night or any evening that will suit you.

THE COURT: Well, unless you have some special reason, next week.

MR. SHERIDAN: No, no special reason.

Q. 13. Now, Professor Beach, if you had not finished, will you kindly continue?

A. I was discussing at the close of the session, some methods by which we could judge quantitatively of the degree of wetting of a solid by a liquid. Now I satisfied myself that if we put a drop of a liquid upon the clean surface of a solid, the way in which this drop heaps itself up is an indication of its degree of wetting. If I may have a sheet of paper on the blackboard I will endeavor to illustrate what I mean. Suppose that that represents a clean surface of aluminum (Al.) and suppose by means of a medicine dropper you put upon that a small drop of water. By "small drop" I mean two or three millimeters in diameter. Then I find that that drop heaps itself up in some

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such way as that and the angle between the tangent and the surface of that side of the horizontal measured around there, this angle in most of the text books is called the angle of contact; but if you will permit me we may perhaps change that designation here. Let us call it the angle of repose. This is a heap of water and it finally seats itself so that it has a certain angle toward the horizontal surface. I find by referring to my notes of some measurements that I carried out upon this, that that angle, call it "theta" was 85°, with a variation either side of something like 1°. This was water and this was an aluminum surface. I tried a similar experiment, putting on it a drop of oil, for example oleic acid, and in that case—

Q. 14. Will you mark that "Oleic acid" please?

A. (The witness marks the word "Oil"). In general a drop of oil does not heap itself up in the way that the water does, but flattens itself out. I do not happen to have in my notes exactly what that angle was, but it was very small. Now, we judge of the degree of wetting, or the intimacy of the contact, the adhesion of the oil to the aluminum compared to the adhesion of the water to the aluminum by this angle that I have called the angle of repose. So here, we have a way of testing or examining what has been called the affinity of the liquid for the solid or the degree of wetting of the solid by the liquid.

THE WITNESS: I would like to call now for the chart which Professor Taggart showed in his testimony yesterday.

Q. 15. Are you through with that chart there; if you are, kindly mark it "Beach diagram No. 9".

A. I have marked it "Beach diagram No. 9".

MR. SHERIDAN: I offer the diagram in evidence.

Diagram No. 9 admitted in evidence and marked DEFENDANT'S EXHIBIT 132.

(Taggart diagram No. 3, defendant's exhibit 126, handed to witness).

THE WITNESS: In the experiment which was shown to the court yesterday and of which this is a diagrammatic representation, we observe that the oil heaped itself up; that there was a very small portion of the surface of the quartz in contact with the oil, the oil being immersed in water; on the contrary. there was a considerable degree or area of contact with the oil and the galena. Here we have, then, of the principles which I have enunciated, experimental evidence, using different substances, different kinds of gangue, different kinds of sulphide and different kinds of oil, a means of judging how good this oil is in selecting the galena, and how good the quartz will be in rejecting the oil that is setting in the water. I will return to this discussion after having announced and explained certain other facts. This was the first one of the three facts which I propose to discuss, namely, the selective adhesion of a liquid for a solid.

Now, the next fact that we need to consider is the question of surface tension, the existence, and the possibility of varying surface tension. Every liquid

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surface behaves as if it were under tension; it behaves in some respects like a stretched elastic membrane; this, however, is only a way of looking at it. The thing that we actually observe is that when the constraints are removed, the tension is relaxed. It is merely a mental picture. We do not say it is actually under tension, but it behaves as if it were under tension. This is a well known and accepted and undisputed fact.

Now, I want to introduce another way of looking at this phenomena. I want to show that every square centimeter of any surface has associated with it a definite amount of energy, which is numerically equal to the surface tension, and this will be a little more helpful way of viewing the phenomena for our purpose. Consider~~ing~~ any body, and imagine that it consists of two parts. Those parts are not separated at present; those are tied together and held there by ~~a~~ very strong forces. It would take a pull of many pounds to separate those two parts of the body. Those forces are called the forces of cohesion; in other words, in order to separate those by pulling them apart, we have got to do a considerable amount of work upon the body. Now, after those parts have been separated, that energy is regarded as residing in the body in the surface produced by separation; for, if we were to bring these parts together close enough, in sufficiently intimate contact—not experimentally, but theoretically, they would unite. In the case of certain substances such union does take place. I am told that in ship-

ping fine plate glass it is quite necessary to have sheets of paper or something between them; otherwise they are likely to weld toegther under the influence of the pressure. If we were to take two flat surfaces of lead and push them together, even with my hands, the cohesion would be shown to a certain degree, and I would have to pull a small amount in order to separate them again. I simply have got back a certain amount of this energy if I allow the surfaces to reunite.

Now, another way of looking at that is this: that whenever we produce a new surface, we have added a certain amount of energy, and when we allow that surface to disappear by a complete union, we get the energy back again. It is not very obvious in the case of solid bodies, but in the case of liquid bodies it gives rise to important phenomena, the phenomena of surface tension.

Now, I want to show that the measure or the numerical value of surface tension is numerically the same as the surface energy, and in order to do that, I will draw another diagram. Suppose I have two parallel wires. One of these wires I will designate by the letter "M" and the other wire by the letter "N". Suppose I put across the first pair of wires another wire which I will designate by the letter "R". Now, suppose that I put, up close to this wire, a fourth one which I will designate by the letter "S". Now, upon these two wires which are practically in contact, suppose I put a soap solution, so as to form a film between

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those two wires and then, taking hold of the wire "R" and the wire "S", I separate them by a certain distance, which distance I will call "L". In order to do that, and in order to hold that in this position which it is to retain here—this rectangle being covered over with a soap film, and the soap film tending to contract —in order to keep this film stretched I must exert in that direction a force, which I will call "F".

Q. 16. Will you letter that wire which you have last indicated?

A. S*1*. The new position of the wire "S" is called S*1*. You must exert on the other edge of this film an equal force, F. We will also, if you please designate the distance, between the wire M and the wire N, that is the breadth of our soap film, by the letter b. In stretching out this film we have done a certain amount of work which we may write in this way, "W". W represents the work done by the force F in moving the wire S from the position S to S*1*, and the work done is the force F multiplied by the distance 1, which the wire moved. Now, consider the area which was inclosed there. The area of this film, the length 1, multiplied by the breadth b. But in a solid film we have two surfaces, an upper surface and a lower surface and each of these liquid surfaces has a liquid tension so that the total area involved in this particular experiment is the area of our surface 1 x b, and the same area below. So, in order to get the work done per unit area of all the surfaces involved we must divide by 2A and, substituting the value of A, we

have F1 divided by 2b x 1, or cancelling out the letter l, we have F over 2b. That is to say, the force required to maintain this film stretched, divided by the total length of the film involved, which is the length b on the top side and the length b on the lower side. Now this force per unit is what in all text books is called the measure of the surface tension and will be designated by the letter T. This very simple equation shows that the work done per unit area is numerically the same as the surface tension. Then in an ordinary soap solution, a fairly dilute soap solution, I suppose that the surface tension is numerically about 27 dynes per linear cm. and that numerical value can easily be stated as 27 ergs per square centimeter. So, according to the kind of problem that we are discussing we may either think about the forces that are involved or we may discuss the amount of energy which is associated with both areas of the surface.

Q. 17. Will you kindly mark that diagram "Diagram No. 10"?

(The witness marks the diagram "Diagram 10.")

MR. SHERIDAN: We offer the diagram in evidence as Beach Diagram No. 10.

MR. WILLIAMS: No objection.

The diagram was admitted in evidence and marked DEFENDANT'S EXHIBIT 133.

THE WITNESS: I would now like to state one

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or two facts in regard to surface tension or interfacial tension, that this tension depends upon the nature of the substance on either side of the interface; depends upon the temperature; it is the same in all directions in the surface; it is independent of the thickness of the film when that thickness exceeds a certain minute value. Now, if we may return again to the relation of the drop of oil upon sulphide and a drop of oil upon quartz we could get some interesting and important relations which will be used in further discussion. Let us consider first the drop of oil upon the sulphide. This horizontal line will represent the upper face of sulphide. Suppose that we place upon that sulphide in the presence of water, a drop of oil. Suppose that this region here represents water. These are the conditions of the experiment as they were tried in the test yesterday. Consider that point which is just at the edge of the drop of water in the water. There are meeting there three surfaces or boundaries, the sulphide—oil surface, and in that interface there is a different amount of energy or interfacial tension which I will represent by an arrow and I will letter it Tso. That means the tension in the boundary between the sulphide and the oil. In the water-oil interface there is another tension which I will designate as Tow. In the boundary between the sulphide and the water at this interface there is another surface tension which I will designate by Tsl, which subscription one refers to the medium immediately above the

sulphide. Now when that drop has come to rest that particle may be regarded as in equilibrium under the action of three forces. If we call this angle of repose here by the letter theta, then the position of equilibrium may be written in this way, that the pull toward the left, which is represented by Tsl is equal to Tso—Tow times the consine of theta. The consine of theta giving merely the horizontal component of this force. Now, looking at this equation, Tsl is necessarily greater than Tow, because 2s1 is equal to Tso plus something else. In other words, the surface tension out here is larger than it is at that point. In other words if we could, in any way, cause that surface tension to diminish then this point would be drawn farther and farther out. Then we see the degree of intimate contact of one liquid for a solid means a small interfacial tension. These are conditions which we have in the case of the oil upon the sulphide, discussed in terms of the force. Now I have shown that these tensions are the same thing as the energy associated with each unit area. By the principle which may be discussed further I have stated the potential energy of any system tends to diminish. We have here a relatively larger surface energy than that there. Now, by cutting out some of this surface we diminish the surface energy of the system, so in this particular case the area covered by the water, viz., Asl tends to diminish with respect to the area covered by the oil (Aso). Our experimental facts have now been stated

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in language which will be very useful to us. When you put a drop of oil upon sulphide under water, the area covered by the water tends to diminish; the area covered by the oil tends to increase.

THE WITNESS: Now, obviously, if we are using small particles of sulphide, the greatest possible area that can be covered by the oil, of sulphide, is when the body is within the material of the oil.

Here, then, we have stated in definite scientific language a fact which is illustrative of the flotation process, namely, that the sulphides tend to bury themselves within the material of the oily substance.

Now, suppose we apply this same reasoning to the drop of oil on the quartz. I will number that diagram "Beach diagram No. 11."

MR. SHERIDAN: We offer in evidence the diagram marked "Beach diagram No. 11."

Said diagram admitted in evidence and marked DEFENDANT'S EXHIBIT 134.

THE WITNESS: Suppose next that we illustrate the case of the drop of oil upon quartz. This horizontal line which I have drawn represents the upper face of the quartz surface. In the experiment yesterday a drop of oil was seen to take a shape something like this. This medium above it and outside of the oil is water. We go through precisely the same steps of reasoning as before, considering a particle of oil at that point. The angle which I have called the angle of repose—the

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angle of the tangent at that point that it makes with the horizontal surface, in this case I will designate that as phi. Here we have a tension between the boundary of the water and oil called Tow. In the boundary between the quartz and the liquid above we have another tension represented by the letter Tql; and at the boundary between the quartz and the oil we have another tension, which I will designate Tqo. These three forces I will shade so as to make them clearly conspicuous. The difference of equilibrium between these three forces is this: Tqo is equal to Tql plus Tow times Cos. phi, from which we draw the important conclusion that Tqo is greater than Tql, because it is equal to Tql plus something else.

Now, as the surface tension is the same thing as the surface energy, we see that the surface energy of the oil-quartz surface is greater than the surface energy of the boundary between the surface of the material Q and the region which I have called 1. Now, as this potential energy tends to a minimum, the surface having the greater potential energy will tend to diminish; in other words, the area of the surface Qo will tend to diminish with respect to the area Q1; that is to say, this drop of oil, when it is put on a quartz surface tends to draw in together; it is as if you had the water surrounded by an elastic skin; the greater the tension there is in this lower surface, the more it will gather it in together. It is the contrary or converse case to that we had before, where you diminish

the tension of the surface and the thing tends to let go or spread out.

We have now established these two things, that the area of a quartz-oil surface tends to diminish; that the area of sulphide-oil surface tends to increase; in other words, if you have particles of quartz in the vicinity of oil and water, the water surface grows larger and the oil surface grows smaller; that is, the quartz finally takes up a position within the water. Similarly the sulphide takes up a position within the oil. This thing was stated yesterday by Professor Taggart, and after having marked this diagram I will ask if I may again refer to his testimony, using the diagram which he put on the board.

Diagram last marked Beach diagram No. 12.

MR. SHERIDAN: I offer Beach diagram No. 12 in evidence.

Diagram admitted in evidence and marked DEFENDANT'S EXHIBIT 135.

(Defendant's exhibit 130, diagram 7, handed to witness.)

A. Professor Taggart's diagram represents a vertical boundary between oil and water. This particle is one of sulphide, and this particle is one of gangue. Now, by the principles which I enunciated and rested upon a secure experimental and rational foundation, lead exactly to the results as stated yesterday. The

surface energy of that portion to the left of the line "CD"—

Q. 18. The portion of what, professor?

A. The portion of sulphide in contact with the oil —has a smaller surface energy than the sulphide in contact with the water. Now, by the principle of potential energy, it tends to a minimum. When a particle is wholly immersed in oil, the total surface energy is less than when it is partly in oil and partly in water. Similarly, in a particle of gangue, the surface energy of the tension of the gangue to the left of "CD," namely that portion wet by the oil, has a larger surface energy than the portion of the gangue to the right of "CD," namely that portion which is wet by the water. Now, since the total potential energy of this system tends to a minimum, the gangue will move towards the right or into the water. Here we have shown how the selective wetting by liquids of different solids may result in their differential separation in the presence of water, oil or other selecting agents.

I mentioned there were three facts upon which my explanation of mineral flotation in the agitation froth process is based; the three facts are the selective adhesion of the different substances, the existence and variation of surface tension. I have discussed the existence of surface tension, and I wish now to say a word about the variation of the surface tension. In the experiment shown by Professor Taggart in which a drop of oil was placed upon the clean surface of water, a neighboring

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chip—I mean a chip at a point near to the point upon which the drop of ore fell—this chip was seen to jump sidewise, indicating that where the oil touched the water there was a considerable diminution of surface tension, due to the concentration of the oil, or adsorption of the oil at the surface. This variation of the surface tension certainly plays some role—a fairly important role—in the production of stable films. I think I had better discuss that in order to make it clear, by the aid of a diagram.

Suppose we take a chemically pure substance—say, water as pure as we can get it, even though we have a film of water upon a wire ring, or even if we have a bubble on the surface of the water, it only lasts for an instant. If we use water which has been contaminated, which contains something different from the water, we can produce a bubble or a film which will last for a long time. I wish to explain how this is brought about.

Suppose that these lines represent a thin film of water bounded by air on either side. Suppose that the film is held at the top, and that a certain small force or weight was applied at the bottom, which I will call "F". If this force "F" is less than 75 dynes per centimeter, then the surface tension or the tensile force of this film would at least theoretically support the weight. If, however, the downward pull was greater than that, the film would stretch, thereby becoming thinner and thinner. Now, suppose that the thickness exceeds a very minute limit, there is no change in the tension of the surface. If we

are to have a water film upon a ring, and hold it in a vertical position, under the influence of the weight, the water would gradually drain down toward the bottom, the upper parts of the film would have to support a greater, gradually increasing weight, with the result that it will gradually thin out a little more and more. There is nothing to prevent this thinning; there is no counter balancing force greater than the surface tension, and the thinning is soon brought down to the point where the bubble film will break. It is a very homely illustration, but it is very much like taking some soft gum, like chewing gum, and pulling it down; it stretches out, and as the cross section of this thread becomes thinner and thinner, finally it breaks. Now, in order to get a stability in a condition of this sort, we must have something different. I hold in my hand an elastic band. Now, suppose I stretch that elastic band. As I pull it down it becomes thinner and thinner. But I also notice that the force of restitution, the elastic force of the band, becomes greater and greater. This is the so-called Hook's law of elasticity. In proportion as the force acting upon the elastic body produces a greater stretch, by so much does the force of restitution increase. So that, in the case of this elastic band, if I hang on it a weight, it will settle down to a certain place, where the backward force, the resilience, or the force of restitution of the elastic band is equal to the weight. Now, how can this happen in a film of any sort? Say a film made with a soap ~~of~~ solution. Let this portion of the diagram rep-

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resent a film made of soap solution. Suppose now that we stretch this film out; what will happen? Well, it is first necessary to assert that whereas the surface tension of the pure water was about 75 dynes per centimeter—I am speaking in round numbers—that the soap solution, under exactly the same conditions of temperature and surroundings, will have a value of only about 27 dynes per centimeter. Soap—the particles of soap when they get into solution or mixture in the water affect the surface tension; they tend to diminish the surface tension; that is to say the surface energy of the soapy water is something of the order of one-third as much as that of pure water. Now, as this potential energy tends to a minimum, the more soap that you can get—the more particles of soap—I mean microscopic or molecular particles of soap that you can get into this surface layer, up to a certain limit, the more will the surface tension diminish. Now, that diminishes down to about one-third of its initial value for pure water, and there the process no longer proceeds further. So we start with a film which has less tendency to contract. We have a strong contractile force in pure water and a much feebler contractile force in soapy water. Now, that of itself will assist in the durability of the film. The stronger the surface tension the more difficult it is to make a bubble. For instance, it is easier to make an independent bubble of water than of mercury, for the reason that the surface tension of mercury is somewhere in the vicinity of four or five hundred dynes per linear centimeter. In the

first place you can make this film and it will not have so much contractile force. Secondly, the soap which has gone into the solution tends to increase the viscosity; the mobility of the film is less; the particles of the film do not move with respect to each other so rapidly; but more important than all is this, that we have a means here, just as we had in the rubber band of stiffening the thing up when it gets too thin. Suppose that I represent by these dots little particles of soap which are in that region; suppose that there were ten of those dots or particles, to fix our ideas. Now, imagine that I have stretched this upper portion here out.

Q. 19. Will you mark that portion, professor?

A. I have marked it with a small "a". Suppose we fix our attention upon this portion, small "a", for the soap film, and suppose under the influence of an external force this is being gradually thinned out. I think you see now that these particles which are distributed through that layer, have now been scattered or spread out so that they extend through a longer portion or a larger portion of it; that is, the number of particles in an area "B", equivalent to the original area "A"—that surface is now much less—say five. What happens? When there were ten of those particles there, the surface then—the surface tension then was 27; when I have only five particles there the surface tension returns to a condition more nearly that of pure water. The surface tension will be larger then in proportion as the number of these particles thins out. Then as your soap film

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gets thinner and thinner, it has more and more elastic force, just as this rubber band did, and so we have the condition of a stable soap film, which is why a soap film will last so long. I have seen soap films that would last, stretched on a ring, for one or two hours, and I have never seen a bubble in pure water, if I formed it last more than a fraction of a second.

Q. 20. Will you kindly mark that diagram #13?

A. No. 13.

Diagram marked DEFENDANT'S EXHIBIT 136, and admitted in evidence.

I have now discussed sufficiently the three facts, experimental facts of physics upon which the explanation of flotation process rests. If the court please, just for the sake of the label, I might refer to these as the Beach-Taggart explanation, to define it from other explanations. I have shown that different solids have selective adhesion for different liquids; I have discussed the experiments as to the variation of surface tension and shown the conditions for a stable film. The chief factor, probably, in the stabilizing of a film is the increase of viscosity. Suppose the increase in the viscosity in a soild solution is not relatively great. The chief factor there is the variation of the surface tension, but in some other case, for instance in a Saponine solution, the change in the surface tension is not so much from other water as it is in solid solution, but the increase in the viscosity is very great. The increase in the viscosity of

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a liquid surface, due to the presence of fine particles was shown yesterday by Prof. Taggart experimentally. And, if the court pleases, I would like to say one word more about the principle of minimum potential energy which is an important one in the discussion of physical problems. If we are dealing with an elastic band it is very convenient to discuss the forces which are involved. We can see the points of attachment and we can get at the stretched portion to measure this force. But there are certain other cases where it is very difficult to form a picture of this force. For instance, if we have a reservoir of compressed air, we know that the air exerts a certain amount of force upon the containing envelope, but we do not always care to localize the force. We speak of the pressure of the system. If we are dealing with electrical phenomena, if for example I were to electrify a rubber rod, and bring it near a feather or a small piece of paper, we should find that the paper seemed to be attracted to the electrified rod, but we can not see the medium by which these forces are acting. In cases of that sort it is very much better to discuss the energy relations. So, as in the case of compressed air, we do not speak of the force of the air as much as we do of the pressure of the air. So, in dealing with electrical conditions we do not speak of the force as much as we do of the potential energy of the system. For example, in an ordinary trolley system. I do not happen to know what may be here, but in my own home at New Haven, the trolley wire has a certain amount of potential energy

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which is greater than the potential energy of the rails by an amount which is called 500 volts energy per unit charge. And we say that the electricity runs from the higher potential to the lower,—body at the lower potential. It is the exact analogy of the pressure of the air in the tank. The air flows from the point of greater pressure to the lower pressure. The air goes from the place of the higher potential energy to the place of the lower potential energy. The electricity flows from the places where it has high potential energy to the place where it has lower potential energy. Now, to top off my conclusion, that is, the discussion of the flotation problem, we are having particles move from the place of greater potential energy to smaller potential energy; so, we have to discuss the specialized or localized force, if we find that in a certain position a particle has less potential energy than it would have in some other place, that is the place into which it will move automatically, or by itself. For that reason we have contaminants adsorbing into the liquid surface: it diminishes the surface energy. It is the reason we have sulphide going into oil or oil contaminated liquid, because the oil has less potential energy when it is so surrounded than if it was in the water. The quartz goes into the water because there it has less potential energy than it would have if it were in the oily layer. I have thus tried to lay a sound physical basis, facts which I believe are accepted by all students of physics, as the basis for the Beach-Taggart explanation of the flotation phenomena in the agitation cell.

Q. 21. What does experiment 5, sprinkling ore on water, show?

A. It shows an increase of viscosity of the surface layer, including the mineral particle. The portion of the surface which contained the chip was not at all disturbed by the motion of the needle, was not sensibly disturbed by the motion of the needle when there was no powder on the surface. When the powder was scattered over, the whole surface moved almost as if it were a solid body.

Q. 22. What do you mean by viscosity?

A. Well, in popular language, viscosity is internal friction. If I move a book along the surface of the table there is a certain resistance to the motion of the book with respect to the table. In the case of a fluid, when we move one particle of a fluid with respect to its neighboring particle there is similarly a resistance to this motion which is called internal friction and which is a measureable thing and is called viscosity.

Q. 23. Can you illustrate this idea of viscosity in some other way?

A. Suppose we start with a beaker of water and we pour into it some finely divided particles. As we increase the number of these particles which are, we will say, merely mechanically inclosed in the liquid, it takes on a consistency which is more like that of a syrup, it pours more slowly. If we incerase the number of these particles more and more we finally get it to a paste, the substance becomes so sticky or so viscous that it may be

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moulded in the fingers. A good example of this is putting whiting in oil, which makes putty. Putty is an example of a substance which is very stiff or viscous. It flows under the force exerted by the fingers, but it flows with difficulty and very slowly.

Q. 24. What is your idea or explanation of this increase of viscosity?

A. Suppose we were to take two surfaces of glass—I can do that best by illustration. Let the line A represent the surface of a glass plate. Let B represent the surface of another parallel plate, and suppose that the region between these is filled with water. Now we are going to move these plates parallel to each other. The water clings to glass. The particles of the water which are right next to the glass are practically adherent to it. The same is true on this side. Now, when these plates slide, one up and one down, the particles which adhere to the glass move with the plates. The other particles that are nearby are entrained a certain amount but the particles which are in the middle space, provided that is not extremely small, will be just about as free to move as if they were in a large pond of water. Now, suppose we diminish the distance between these surfaces. I will represent the plates again by position A_1 and position B_1. Now, you see the particles which attached first to A and also to B are in very close juxtaposition. As we slide the plate A^1 up and B^1 down, the particles stick to A, move with the plate, and those sticking to B move with that plate, but the particles which are in the

very small distance in between there more or less adhere or rub against these partially fixed particles on the plates so that it is obvious, it seems to me, that the motion of the plates with respect to each other are somewhat retarded by the resistance of these particles that rub against each other. There is a true friction between the parts of a liquid, such as water. All fluids show a certain amount of internal friction or viscosity. Now, that is exactly what happens in the case of the paste that I spoke of. If we magnify these particles enough, these a, b, c, ~~w~~ d, if these represent particles of the powder that we put in the liquid and if the little interstices of these particles are regarded as filled up with water, then it is obvious that the particles as a whole are not very free to move; they are hampered by the adhesion of the particles of the liquid on the faces which are juxtaposed. That, in popular expression, is my idea of why a paste becomes so viscous.

Q. 25. Will you kindly mark that diagram 14 and initial it?

(Witness marks the diagram.)

MR. SHERIDAN: The diagram so marked is offered in evidence on behalf of the defendants.

MR. WILLIAMS: We have no objection.

Said diagram was admitted in evidence and marked DEFENDANT'S EXHIBIT No. 137.

Q. 26. Professor, you saw the test No. 3 that Prof. Taggart made yesterday, with the beaker, the red ink and the water and the oil?

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A. Yes.

Q. 27. What does that show?

A. I would like to have the diagram that he drew for that, if I might.

Q. 28. It is on the blackboard, Professor, and it has not been offered in evidence as yet.

A. This experiment calls attention to the peculiarities of the binding surfaces or interface between the oil and the water. That interface is obvious. If you look down on it at a small angle it looks shiny, has almost a metallic lustre; but it possesses certain other properties which are important. It shows that there is something there which is different from the pure oil and different from the pure water. There is, in other words, a transition layer here in which, as I apprehend it, the particles of oil are intermingled or mixed in varying degrees with the particles of the water. This transition layer we call an adsorption layer. There is more or less concentration of the

P. 3059, L. 22, insert "water, and on the water side it contains some particles of" after "of"

This is the fabric of which the bubble film in the flotation process is made up. Recalling Prof. Taggart's description, when a bubble of air is released it rises by its buoyant effect, it entrains some of the water in the region; it gradually lifts to the surface which bows over as this elevated portion raises still farther. It necks off at the bottom and incloses some of the colored water. We have inside

there, sir—we have an adsorption layer of air, water passing from the hole into the water. As we pass from the water into the oil we have another adsorption layer which is almost a skin, if I may use that term, or membrane, out of which we can make bubbles. These rise to the top and this skin may remain intact for a short time and show the reddish color when looking down upon it. But, after a little time on account of the considerable weight that is there dragging it down, that bubble film of the oil-water adsorption layer thins out and breaks and this portion which is sort of like a watch glass or crescent, falls down, will return to the lower surface. Sometimes it will rest on that for a number of minutes before it unites with it. And the distinguishing thing about it is that it does not draw itself together into a spherical drop as the ordinary drop of rain would, falling through the air. It has a very viscous film. And this film is capable of making bubbles. We can fill it full of air, we can fill it full of water, or we can fill it full of oil. I do not know at the moment, but I think I can easily show that we may have that viscous film filledwith somewater in bubbles containing no air above the surface and we may have that film filled with oil and appearing below the surface. In this connection I would like to introduce if I may—

Q. 29. (Interrupting.) Let me ask a question: Can you show by experiments how the presence of solid particles at an oil-water contact results in increasing the viscosity of the interfacial film at the oil-water interface?

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A. I will endeavor to do so. I have here a bottle into which I will pour a layer of water. This is ordinary tap water. In this bottle I will pour a layer of kerosene. There were temporary bubbles filled with water formed there in the kerosene. I will introduce into this bottle an amount of copper—finely divided copper, bronzing powder it is called. I am now agitating this mixture and will allow it to stand for a moment or two and there will be seen pendant a short film, a flattened film which when looked at by reflected light looks as if it were copperplated. When looked at by transmitted light it shows a lacey pattern. This is a bubble film which has inclosed within it a certain number of these copper particles.

MR. WILLIAMS: Just mention that you shook it again.

A. I have again shaken the bottle. I have here a specimen of the same film which is not air formed here in the copper, but which illustrates the great viscosity of that particular film. Now, in an experiment which I have actually carried out here I will call your attention to the extreme viscosity of that film which now hangs in a vertical position and I would like the court, if the court pleases, to examine it by transmitted light and by reflected light.

Q. 30. THE COURT: What is the purpose of this?

A. This is to show how this interfacial film, which is the fabric by which bubbles are made, has its viscosity very greatly increased by the metal particles which have become imbedded into the film.

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Q. 31. MR. SHERIDAN: Which become imbedded in the film or the interface?

A. Imbedded in the film.

Q. 32. THE COURT: This film hanging down is oil and metal particles?

A. Well, it is the adsorption here. It is the same dividing layer which is seen in this experiment, only it now has been over-weighted so that it hangs down and if your honor will look at it by transmitted light, that is, towards the window, you will be able to see the spaces between the particles, that the film is not completely filled; it shows tracery, lace-work. The film is evidently very viscous, it does not tend to contract as ordinary films do.

MR. WILLIAMS: We would like a specimen of the bornzing powder.

Q. 33. What is that, a powdered copper?

A. I don't know how it is prepared; it is called pulverized copper, which is used by painters for bronzing.

Q. 34. MR. SHERIDAN: Professor, I would like to ask you what you mean by a film? Is the film you are speaking about a film composed by oil in which there are minute particles imbedded, or water in which there are minute particles imbedded, or is it that material, that layer that you call the adsorption concentrate layer between the oil and water face?

A. It is the transition layer, what I call the adsorption layer or adsorption film consisting of particles of water molecules, particles of air molecules, particles of

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oil, and in this case it has imbedded in it some particles of metallic copper. If they were blown up into spherical form it would be exactly like the froth which appears in the concentration cells.

Q. 35. And the presence of the particles that formed that copper powder does what, in that film?

A. These particles make the film viscous in the same way in Prof. Taggart's experiment, the ore which was sprinkled over the surface of the beaker made it viscous, tended to move more like a solid body than like a liquid body. Have I made myself clear?

Q. 36. Yes. Now, returning to the mineral agitated froth. What is the function of the oil in mineral separation?

A. I apprehend that the oil serves two functions. It makes this adsorption layer from which bubbles may be constructed and by its selective adhesion to the sulphide particles or, conversely the selective adhesion of the sulphide particles to this adsorption layer, the particles are separated away from the quartz and brought up to the surface.

Q. 37. Now, Professor, before you depart from this subject I would like to have you give a complete explanation of your test, which we call test No. 12, that you just performed with the glass bottle and copper powder so it will appear on the record.

A. With a diagram?

Q. 38. No, not a diagram. I wish to have you give a complete explanation of it so it will appear in the rec-

ord. Tell about what you did, materials used, bottles used, and so forth.

A. I selected a glass-stoppered bottle about four inches high, about two inches in diameter. I poured into it a layer of tap water about an inch and a half in thickness, from a wash bottle. I then poured some commercial kerosene from another bottle upon the surface of the water, forming a layer about 1 inch thick. I then introduced into the bottle by the aid of a spatula a small amount of copper powder, known to the painters as bronzing powder, using an amount which would cover about a square centimeter of the surface of the end of the spatula. I then agitated this mixture with the glass stopper in the mouth of the bottle for a few seconds and allowed the material to settle down into its apparent levels. After an interval of a few seconds I again agitated it still further and then noticed—

Q. 39. (Interrupting.) For how long; just state how long you agitated it the second time.

A. Less than ten seconds I think. I do not understand that the time of agitating has anything special to do with it. I then noticed when the fluids had come to rest in the bottle, that there was hanging a web-like structure from the interface of the oil and the water into the layer of water. This is the bubble film matter or the water-oil adsorption layer hitherto discussed. In this particular case it was seen to contain a great number of copper particles. When looked at by reflected light the whole surface appeared as if it were copper

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plated. When it was looked at by transmitted light it had the appearance of a cobweb which has been exposed in a dusty place for a long time. The light can be seen through this filmy structure and one can, undoubtedly, if his eyesight is sufficiently good, pick out the individual particles of the material. The weight of this material stabilizes the film so that it has already remained in existence I should think for about ten minutes, hanging as a cobweb from the upper surface and resting on the bottom of the bottle. A slight agitation of the bottle shows that this is a very viscous film.

MR. SHERIDAN: If you would like to examine the witness on this test before it disappears you are at liberty to do so as far as I am concerned.

MR. WILLIAMS: No, I don't wish to now.

BY MR. WILLIAMS:

X-Q. 40. Professor, I would like one further explanation. Is that film or curtain-like structure filled with kerosene or air?

A. Well, I will answer to the best of my knowledge after looking at it since it was formed. It is my opinion that it consist of intermingled particles of kerosene and water, forming the so-called adsorption layer. It also contains imbedded within it some mineral particles—particles of the copper powder, and I am not able to discover, looking at it with the glass, that it does contain any perceptible number of air particles. I do not exclude the possibility of there being some minute particles there, but there certainly are not enough to float it

to any degree, and I have not examined it under a powerful microscope.

X-Q. 41. The amount of agitation to which you subjected it was a comparatively gentle agitation, was it not?

A. There was no intention—it was simply to shake the things together. I have not performed this experiment very many times, and I cannot say that a long shaking or a short shaking or a horizontal shaking or a vertical shaking have anything to do with it. The idea is simply to intermingle the substances.

X-Q. 42. Now, that oil there does not contain any visible air, does it, as the result of the shaking?

A. I would like to say that the water bottle which I used contained air; the water was not free from air; I presume very likely there may be some small adhesions of air.

X-Q 43. It is a characteristic of Butte water that it contains air for some time, isn't it?

A. It is a characteristic of water under pressure at any time that it contains air. I am unable to say that I can see any particles of air with the power of the microscope which I have in my hand.

X-Q. 44. Then that other one that you produced that was done some time ago, there is not any air in that oil there at all, is there?

A. Not in so far as I know.

X-Q. 45. The metal is practically all down at the interface between the oil and the water, is it not, in both cases?

A. No.

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X-Q. 46. First we will take the one that was introduced first?

A. I did not intend to introduce this as an exhibit.

MR. SHERIDAN: Well, refer to it anyway.

X-Q. 47. MR. WILLIAMS: It is instructive to examine it anyway.

A. No, it is all at the interface.

X-Q. 48. Well, a part of it at least?

A. Well, there is some at the upper surface, I cannot say how much there is there. If you remove the cork you will see that there is some there at the surface.

X-Q. 49. There is some of the metal floating at the top of the kerosene layer, and apparently a larger amount—or at any rate a considerable amount of metal floating at the interface, and practically no metal in between the top face of the oil and the interface of the oil and water, that is right?

A. There seem to be no copper particles in the mass of the oil that is away from the surface. There are particles of copper—in this specimen the copper is in the oil.

Q. 50. That is the last test which you made; it has not all settled out probably?

A. It has not settled out; but the copper particles appear at the interfaces; the interface of the oil and the glass, the interface of the water and the oil and the interface of the oil and the air.

Q. 51. I presume you have observed that metal par-

ticles tend to settle to the bottom of an oil layer when that oil layer floats on water?

A. Some of them do.

Q. 52. That is the extent of your observation, is it?

A. Some of them do and some of them may not.

Q. 53. But in your experiment, the one that was done before the court opened, there has been substantially a settlement of the metal particles to the bottom of the oil layer, except for those particles that are floating on top of the oil layer?

A. I think so.

Q. 54. MR. SHERIDAN: Then, just carrying Mr. Williams' question further, the metal tends to go to the interfaces between the two different liquids or a liquid and a solid?

A. The statement of the result I would put this way, that the metal goes into that medium where its potential energy is least.

Now the conditions are somewhat variable. The potential energy of some of the particles may be least at the air-oil surface, in the case of film flotation. In this I judge that the copper particles have less potential energy at this adsorption layer than they have in the liquid kerosene. Some of them, also, have found positions of equilibrium, creeping up the side of the glass jar. Some of them are entangled up at the top on the cork.

Q. 55. Going back to the agitation froth process, is there any difference in the function of the oil when the

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percentage is less than one per cent or when it is over one per cent?

A. No; in my opinion no.

Q. 56. Is there any point at which the function of the oil in the mixture undergoes a change, short of the simple bulk oil flotation?

A. None whatever.

Q. 57. Will you kindly state, if you know, or state what your opinion is, if there be any difference between an air froth and an oil froth?

A. I am not sure what you mean by an air froth and an oil froth, but I will try to answer the question. If by an air froth is meant one which is formed with a small quantity of oil, more than a fraction of one per cent—more than one per cent—I say there is no difference between those two froths. Have I apprehended your question?

Q. 58. I think you have answered it all right. As I understand, the only difference there would be between froths formed with a fraction under one-half of one per cent, and within reasonable limits up to 25 per cent, would be the amount of oil in the froth?

A. A difference in degree, but absolutely no difference in kind.

Q. 59. In what respect does an agitation froth made with a so-called insoluble oil differ from an oil froth made with say a soluble contaminant, such as creosote?

A. It is a difference in degree, and not a difference in kind. The soluble contaminants may be more effective in producing a foam, and the heavier or selecting

oils may be those oils which have a greater adhesive power of picking out the sulphide.

Q. 60. Did you hear Professor Taggart's deposition yesterday?

A. I think I did, most of it; I am not sure that I did all of it.

Q. 61. When he referred to the fact, as I remember it, that whether it was a soluble contaminant or an insoluble contaminant, that the contaminant tends to concentrate at the interface of the air and gas; do you agree or not with that proposition?

A. The soluble contaminant?

Q. 62. Both soluble and insoluble as I understand tends to have the least potential at the interface between the air and the liquid?

A. The soluble contaminant will concentrate at the interface provided that it lowers the surface tension, and the so-called insoluble oils also do disperse and disseminate themselves to a certain degree throughout what we would ordinarily call the solvent, and if they lower the surface tension they will concentrate at the interface.

MR. SHERIDAN: Mr. Williams, you may have the witness.

CROSS-EXAMINATION.

BY MR. WILLIAMS:

X-Q. 63. Professor Beach, you illustrated in diagram No. 11 the force of surface tension at the oil-sulphide, oil-water and sulphide-water surface?

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A. May I see the diagram again please?

X-Q. 64. Can you give me any measurements as to these forces; take first the force Tso?

A. I don't know of any method by which those interfacial forces can be independently measured; there may be some, but they have not been brought to my attention.

X-Q. 65. And therefore you have not, as a physicist, succeeded in making any definite expression of those forces?

A. I have not attempted to reduce them to numerical value.

X-Q. 66. Is the same true as to diagram 12, wherein, in place of sulphides, you use quartz, and represented again diagrammatically the three varieties of surface?

A. I would say that I am not at present aware of any measurements of interfacial tension between a solid and a liquid. The interfacial tension between two liquids has been measured.

X-Q. 67. Can you give me representations in dynes or otherwise of those forces?

A. I may refer to the authorities for that?

X-Q. 68. Suppose you do it after luncheon?

A. All right.

WHEREUPON an adjournment was taken until 2:00 P. M. Thursday, April 26, 1917.

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2:00 P. M. April 26th, 1917.

X-Q. 69. Now, Professor, can you give me the oil-sulphide tension, surface tension under the conditions shown in your diagram 11?

A. I know of no numerical measure of the tension between a solid and a fluid.

X-Q. 70. Now the oil-water surface tension under the conditions illustrated in your diagram No. 11?

A. I will quote value for oil-water surface tension, 14.

X-Q. 71. Would that be dynes?

A. I assume it is. It is not expressly stated.

X-Q. 72. Now, the sulphide-water surface tension under the conditions in your diagram 11.

A. As I said a moment ago I know of no measure of the interfacial tension between a solid and a fluid.

X-Q. 73. Then we come to diagram 12 and the first item was oil-quartz. That comes under your general statement that there is no measurement?

A. I am not acquainted with any measurement of that.

X-Q. 74. Now the oil-water, under the conditions of your diagram 12, oil on quartz?

A. The tension of the water-oil interface is not affected by the presence of this insoluble solid.

X-Q. 75. So we take 14 dynes, that is what you gave before?

A. That was the value that I quoted from this book.

X-Q. 76. And the quartz-water comes under your—

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A. That is a solid interface and I do not know.

X-Q. 77. Now this oil-water surface tension, is it variable with different oils?

A. Undoubtedly.

X-Q. 78. And can you give me any other date than you have given?

A. For oil-water?

X-Q. 79. For oil-water.

A. I will quote from Freundlich Kapillarchemie.

X-Q. 80. MR. GARRISON: What does that title mean when translated?

A. Capillary chemistry. It is capillary chemistry or the chemical phenomena connected with capillarity. It is a branch of physical chemistry. Page 128, table 30, title page bearing date of 1909.

X-Q. 81. MR. WILLIAMS: Published by who?

A. Akademische Verlagsgesellschaft, m. b. H. Page 128, Table 30, various substances mentioned here, benzol—I would like to say that these involve chemical natures of compounds and not being a chemist I am not absolutely sure as to the description.

MR. SHERIDAN: Do you want to have Dr. Sadtler or Prof. Bancroft interpret it for you?

MR. WILLIAMS: I will not object.

A. Water and petroleum hydro-carbon; water and benzol; water and turpentine; water and isobutol alcohol; water and iso alynl alcohol; water and ethyl ether; water and chloroform, methyl alcohol and carbon bisulphide.

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THE WITNESS (Continuing): Or water petroleum hydro-carbon 48. That is undoubtedly dyne per c. c. Water-benzol 32.6; water-turpentine oil 12.4; water isobutol alcohol, 1.76; water-isol alynl alcohol 4.42; water-ethyl ether 9.69; water-chloroform 27.7. That is all of that list.

X-Q. 82. Now, can you give me the surface tension of an air-water surface?

X-Q. 83. Now, can you give me the surface tension of the air water surface?

A. Do you desire me to read from this book?

X-Q. 84. Are you reading from the same book you did before? If so, mention it.

A. I am reading from the book, but I must read it in German. I won't be responsible for the translation.

X-Q. 85. Well, let Dr. Bancroft read and translate it?

A. Well, I can read it and translate it, but I don't want to be responsible for the translation; I might make a mistake. "The values measured by different methods, pure water at 18°, by different methods" —then there are twelve or twenty different observers. Will it be sufficient if I give the range of values from the highest to the lowest?

X-Q. 86. Yes.

A. The lowest there which I find in the table is 71.9—well, there is one 71.7, measured by method called air bubbles. The observer is Sieg and this

measurement was made, or rather published in 1887. The highest value which I see in the table is 76.8; there are two values; one by Timberg, which was published in the Journal de Physique in 1887. The value was measured or determined by the adhesions to a ring made of platinum.

X-Q. 87. And these are all at 18° C.?

A. I so understand it to be stated here.

X-Q. 88. Now, the oil-air surface tension; can you give me any figures on that?

A. To tell the truth I don't know how many of these oils—but I will read some.

X-Q. 89. I suggest that you lend us the book and we will look it over and put in evidence what are necessary so as to save the trouble of putting in the whole list?

A. The book does not belong to me, and I do not feel that I have authority to let it go out of my hands.

THE COURT: Do you want this to go in as your own evidence or as a part of your cross examination.

MR. WILLIAMS: As a part of the cross examination of this witness.

THE COURT: Suppose you let Dr. Bancroft read it. I suppose you want to use it as part of the cross examination.

MR. BANCROFT: I will be happy to read it for him or to copy out the table for him.

MR. WILLIAMS: Then kindly read the table, and we will get it in the record.

MR. BANCROFT: This is a table of surface tension of organic compounds. First, Hexane; temperature 20°; surface tension 17.4. Kerosene: temperature 50°; surface tension 30. Benzol, temperature 20°; surface tension 28.8. Toluol, temperature 20°; surface tension 28.2. Methylalcohol, temperature 20°; surface tension 23. Ethylalcohol, temperature 20°; surface tension 22. Normal propyl-alcohol, temperature 20°; surface tension 28.6. Isobutyl-alcohol, temperature 20°; surface tension 22.5. Isoamyl-alcohol, temperature 20°; surface tension 23.5. Ethyl-ether, temperature 20°; surface tension 16.5. Glycol, temperature 20°; surface tension 46.1. Glycerine, temperature about 18°; surface tension 65. Acetone, temperature 20°; surface tension 23. Formic acid, temperature 20°; surface tension 37.1. Acetic acid, temperature 20°; surface tension 23.5. Propionic acid, temperature 20°; surface tension 26.2. Normal butyric acid, temperature 20°; surface tension 26.3. Analine, temperature 20°; surface tension 43.8. Pyridine, temperature 20°; surface tension 38. Nitrobenzine, temperature 20°; surface tension 41.8. Chloroform, temperature 20°; surface tension 26. Carbon tetrachloride, temperature 20°; surface tension 25.7. Carbon bisulphite, temperture 20°; surface tension 33.5.

X-Q. 90. MR. WILLIAMS: Those degrees are all Centigrade-

A. All Centigrade degrees.

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EXAMINATION OF MR. BEACH RESUMED.

X-Q. 91. You collaborated, did you not, on the paper entitled "An Explanation of the Flotation Process by Arthur F. Taggart and Frederick E. Beach," portions of which I read to Professor Taggart during his testimony?

A. No, sir, not in that paper.

X-Q. 92. Was it written entirely by Professor Taggart?

A. We did not write that paper.

MR. SHERIDAN: I don't think Mr. Williams should ask that question, so I object to the form of the question. How should Professor Beach know anything about it, if Professor Taggart wrote it entirely.

THE COURT: The form of the question is all right, but it calls for hearsay.

MR. WILLIAMS: He might have seen him write it.

THE WITNESS: If the court please, I would like to state that we did not publish in that journal, and I never to my knowledge read that matter which he presented to the court. It is not our paper at all.

A. If the court please, I would like to state that we did not publish in that journal—I never to my knowledge read that matter that he presented to the court. It is not our paper at all.

X-Q. 93. That is to say, this publication which appears in the Metallurgical and Chemical Engineering. Have you read it?

A. The Journal that you have quoted did us the honor to reprint the paper. It was not by any authorization of my own. I hadn't the opportunity to correct the proof; I don't remember that I ever read the text that you quoted in the court yesterday.

X-Q. 94. I show you a document entitled "Transactions of the American Institute of Mining Engineers" and a paper having the same heading. Will you accept that as authentic?

A. That is our paper, yes, sir.

MR. WILLIAMS: I will have that identified paper marked for identification.

(The paper entitled "Transactions of the American Institute of Mining Engineers" marked Plaintiff's exhibit 138 for identification.)

X-Q. 95. MR. WILLIAMS: I read from the authentic publication: "The importance of flotation lies in the fact that it is primarily a 'slimes process' by means of which the particles of valuable mineral, too fine for efficient gravity concentration, are saved with a high percentage of recovery. Recoveries in the mills treating low grade copper-sulphide ores have been advanced twenty per cent by the installation of the process and similar increased savings can be accomplished by the same means in mills treating sulphide ores of zinc and lead." You accept that statement as authentic from yourself and Professor Taggart?

A. I have not qualified to testify in regard to mill operations.

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X-Q. 96. That is to say you are a physicist and not a metallurgist and you want to draw the line; is that the idea?

A. I do not feel that I can offer testimony upon that technical subject which would have any weight. I am not qualified as a mill expert or a metallurgist.

X-Q. 97. Were you present when I read these extracts to Professor Taggart?

A. I was.

X-Q. 98. Can we save the time by my asking you whether you accept those parts that I read to him?

A. I did not have the copy of the paper present and I do not know that it was an authentic copy.

X-Q. 99. I read from the authentic copy as follows: "The conclusion ———

THE WITNESS: Excuse me; would you indicate the page upon which that appears?

MR. WILLIAMS: Page 1376.

THE WITNESS: And what portion?

MR. WILLIAMS: Commencing about the middle, under the pictures. "The conclusions forced by observing the above phenomena are:

"(1) That water has a smaller tendency to displace air on the surface of sulphide minerals than on the surface of gangue minerals.

"(2) That the tendency of oil to displace air is greater at the surface of sulphide minerals than at the surface of gangue minerals.

"(3) That oil tends to displace water on the surface

of sulphide and that water tends to displace oil at the surface of gangue mineral.

"(4) That water displaces air more readily on an oiled solid surface than on a clean surface of the same solid.

"(5) That these tendencies toward displacement are due to the interfacial tensions or pressure existing between the various substances, and that the resulting action of this interfacial force is a manifestation of the tendency toward reduction of the total potential energy of the system. Whenever an increase in the solid-fluid interface will decrease the potential energy, such a change will occur." Do you accept that as accurate and as representing your views today?

A. No, sir.

X-Q. 100. Is it accurate—is it an accurate statement of what was published in this authentic paper of yours?

A. Well, I desire to say—I do not understand that I have testified to the contents of this paper. This paper is not a part of my testimony in this court. It was not made under oath. It was done in collaboration with my colleague and was done honestly at the time and represented our views honestly at the time, but I desire to say that I am not prepared to introduce it as my testimony and my language in this court.

THE COURT: Well, the object is, you are here as an expert in reference to special matters in this case and they have a right to ask you about other statements that you have made, not that you have sworn to them.

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necessarily, and to see if your views have changed, also.

THE WITNESS: I would desire to state, the physical facts involved there are not stated in the language which I should use. When two men work together in collaboration they do not always look at the facts from exactly the same angle and they frequently have a difference of opinion as to how particular phenomena should be interpreted and they usually—often there are some compromises between the different points of view. This statement here represents, I think, an average of the views of the two authors of this paper. I should be very glad to state my own views in regard to the phenomena which are involved there, but I would, if the court please, rather not say that these are my words because I do not know that they were used by me.

THE COURT: If they are not, of course you will just state what the facts are, as you remember them. It is not an attempt to try to bind you, Mr. Beach, to any particular view, but that we may have a full understanding of how this was written, and you have stated how it was prepared. You have stated how it was written, and you have a right to explain or modify what you now consider to be the truth of the matter.

X-Q. 101. MR. WILLIAMS: I will say that I haven't the slightest desire to trap you into any statement you will not accept, and my purpose in asking you is to know whether you would accept it. Now, if you will explain your views—if you wish to explain your views otherwise as to these phenomena you will kindly do so.

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A. The paragraph numbered one, I should say, expressing my views in regard to the phenomena which I suppose is the real point or crux of the question, that water will displace air more readily from the surface of the gangue minerals than from surfaces of sulphide minerals.

X-Q. 102. MR. WILLIAMS: Which is the antithesis of this statement, is it not?

A. It is not, no.

X-Q. 103. All right, I will withdraw that then. All right, go ahead.

A. I think that my statement amounts to the same as is made here, but I would prefer to change the language if I were to offer my testimony in regard to this fact. In regard to the next number?

X-Q. 104. Go right ahead.

A. Oil will displace air more readily at the surface of sulphide minerals than at the surface of gangue minerals.

No. 3, oil displaces water more readily on the surface of sulphide than on the surface of gangue minerals. Water displaces oil more readily at the surface of gangue minerals than at the surface of sulphide minerals.

(4) Water spreads more readily on an oiled solid surface than upon a surface uncontaminated with oil.

(5) These displacements can be expressed in terms of the interfacial tensions or energies and the resulting action of these interfacial forces will diminish the po-

tential energy of the system. If a change in the area of the solid-fluid interface will decrease the potential energy, such change will automatically occur when the system is freed from constraint. I think, Mr. Williams, that states in my own language the substance of these paragraphs and I desire to say that I do not believe that the sense or meaning of them has in any point been essentially changed.

X-Q. 105. Following what I read and what is expressed in your own language, the paper says: "These conclusions suggested the following confirmatory experiment," and then there is a description and an illustration of an experiment wherein an aluminum ring was cleaned and floated on the surface of pure water, and then the ring was oiled slightly, and it was found that the water came over the surface and that it was impossible to float the ring. You accept that experiment as an accurate experiment, do you not?

A. I do. I would like to enlarge upon that statement a little.

X-Q.106. Go ahead.

A. I hold in my hand the aluminum ring in question. This ring was floated on clean water. (Drawing diagram.) I have not all the figures in my note book; I think the statement of the dimensions of the ring and the density as given in the paper are correct. This ring was cleaned by washing it with a cake of sapolio, or bon ami; it was washed with soap, thoroughly rinsed, and taken up in clean filter paper so that it did not

come in contact with the fingers. A small wire carrier with three projecting prongs was used to hold it and drop it down upon the surface of the water. The ring then floated under the influence of the forces of surface tension, which were applied at lines of contact, running around this outer portion of the ring, and the inner portion of the ring.

Q. 107. MR. SHERIDAN: Do I understand that those are two rings, or is it a cross section?

A. This is a cross section of this particular ring, the dimensions being given in the paper.

X-Q. 108. The ring lies horizontal upon the surface of the water?

A. The ring lies horizontal upon the surface of the water. I then attached to this ring some fine copper wires, three of them, I think, making a little basket or pan in which I could put shot, endeavoring to find out how much load in addition to its own weight this ring would support under the influence of these forces of surface tension "T".

X-Q. 109. MR. WILLIAMS: You might mark "basket" at the bottom.

A. I have marked it "basket and shot". I did not expect that this would be called for at this time, therefore I have not provided myself with the data. I will quote from memory, which is to the best of my knowledge and belief. The total added weight which it was possible to put on there was something like 1.7 gms.; I am sure it was over 1 gm., but I am not quite sure

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whether it was one and six-tenths or one and seven-tenths—a variation of one-tenth. The ring was then removed from the water, thoroughly dried, and taken in the fingers; a bottle containing oleic acid was shaken up and the cork was removed, and I rubbed my fingers on the cork so that they were slightly oiled. I then passed the ring through my fingers and rubbed on a little of oleic acid, not enough so I could see it, but so the surface, I believe was coated with a thin film of oleic acid. I then replaced, or attempted to replace this ring as carefully as possible upon the surface of the water, but I found, with whatever care I exercised, it was impossible to float the ring alone. I then tried it with two different oils; the bottles which I used were labeled "crude oil" and "creosote". They had been furnished by Profesor Taggart from a number of specimens, and I know nothing about the history of the oil. I presume he could state it if there was any question. I then found that with the crude oil the ring acted as though it was going to float, but did not; it just wavered at the surface and then sank. There was evidently a difference between the oleic acid and the crude oil in the matter of flotation. With the oleic acid it went down much more promptly. I then tried another oil which was called creosote on the label on the bottle. I found when I had oiled this way I indicated, simply by rubbing it with slightly moistened fingers, that the ring floated—I am still quoting from memory—for a space of seven minutes while it was under observation. I left

it in my room when I went to lunch, and when I returned I found it was at the bottom of the jar. Whether the janitor had been in the room and it had been disturbed, I do not know. I do know this, that it at least floated for seven minutes. There was a difference in those effects. Now, this I regard as a confirmation of the statements that I have made, in this way: I took this piece of aluminum, which I cleaned off very carefully, rubbing the surface with an abrasive soap, and then some plain soap, like ivory soap, and washed the ring carefully in water and dried it with filter paper and was careful not to touch it at all, and then from a medicine dropper I put upon that surface a drop of water, and I determined what I called this morning the angle of repose.

(Drawing another diagram.)

I found that the angle, as I stated this morning, was approximately 85°; it varied a little—a degree or a degree and a half either side of that. I then took this surface of aluminum and touched it with the moistened cork of the bottle, and rubbed my finger over it, and put a drop of water on there as before. When I used oleic acid I found the drop had that shape, and that its angle of repose was about 39½°. I tried the other oils. The crude oil—this little wavy line represents contaminated surface. With the crude oil I found 65° and with the creosote I found 69°. These measurements were made after the experiment had been completed.

Now, I would like to refer to my first diagram.

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MR. SHERIDAN: You better mark that diagram No. 15, so you can identify it.

THE WITNESS: Referring to my diagram No. 15, the angle between the tangent to the liquid surface and the tangent to the cylindrical surface of the clean water and clean aluminum was a relatively large angle; that angle in the other cases had been diminished; in the case of the oleic acid the angle was between 39° and 40°. The forces of surface tension in the liquid surface being very nearly horizontal, it had a small vertical component. As this angle was small, there was very little spreading effect.

X-Q. 110. Mark the angle that you say was small?

A. It is this angle here.

A. The angle was smallest in the case of the use of oleic acid. In that case I was not able to support it at all. When the angle had been increased, in the case of crude oil, to 65°, it seemed to be just on the point of being supported, the force had been more nearly the original position of the pure water. When the angle increased a little larger to about 69° as I measured it, I found that it was possible to support the weight of the ring alone for at least seven minutes—I don't know how much longer—and when the angle had been increased as shown here to 85° the vertical component of the force being very much larger, it was possible to support not only the ring but an added weight of something over one gram.

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X-Q. 111. Now, will you kindly mark the other diagram, Diagram 15, and I will offer it in evidence.

The diagram was admitted in evidence and marked PLAINTIFF'S EXHIBIT 139.

MR. WILLIAMS: I will now offer diagram 16.

Said diagram admitted in evidence and marked PLAINTIFF'S EXHIBIT 140.

MR. SHERIDAN: Professor Taggart made two diagrams on the blackboard that are marked Taggart's diagrams No. 1 and No. 2, which we will offer in evidence as defendant's exhibits 141 and 142.

Said diagrams were admitted in evidence without objection and marked DEFENDANT'S EXHIBITS 141 and 142.

X-Q. 112. MR. WILLIAMS: Relative to the statement on page 1385 of the authentic paper in regard to the pneumatic froth process, "sulphide and gangue minerals mixed with water and oil, with or without acid, are run into a tank with a porous bottom through which air is forced. The air bubbles rise to the surface with a coating of solid particles preponderately sulphide, while the gangue particles sink.

"The principles involved in this method are the same as explained in the agitation froth process. The only difference is in the method of introducing air. The result of this difference is that the bubbles in the pulp

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are much larger than in the agitation froth method: they arrive at the surface less heavily laden in proportion to their area; the bubble films are, therefore, less viscous and the froth less permanent."

First I will ask you if I have correctly read from this paper.

A. I believe so.

X-Q. 113. Now, as to these statements, do you accept them as proper statements today?

A. These represent the result of my own observation.

X-Q. 114. On page 1384 I read, "Case 2, Sulphide. Gangue, Water, Oil and Acid ——— The addition of acid has the two-fold effect ~~for~~ of further lowering the surface tension and increasing the adhesion ratio." Have I read correctly from the paper in question?

A. You have not read the adhesion ratio.

oil-solid.

X-Q. 115. The adhesion ratio is water-solid. I thought perhaps it would be just as clear to the several courts who will have to consider this matter with the statement of this ratio omitted. Is that correct now?

A. It is a correct reading of the passage.

X-Q. 116. Now, what have you to say as to that statement?

A. These are the views which we held at the time the paper was written, from observations which we had made. Today I am still of the opinion that the effect of acid is to bring the water into more intimate contact

with the gangue mineral, that is, the adhesion of acidulated water to gangue as indicated by the angle of repose, is apparently a little greater than for pure water in the gangue. I understand you are asking me about the effect of sulphuric acid?

X-Q. 117. Yes.

A. I am trying to answer that question. Today I am of the opinion that the presence of sulphuric acid assists in flocculation or precipitation of the gangue, although I do not offer this as an expert opinion, as I am not a chemist and this belongs rather to the realm of physical chemistry than to physics. In regard to the other statement as to the effect of acid upon the surface tension of the water, I have found various statements of various authorities, some saying that it lowers it and some saying that it raises it. The best information that I am able to obtain at the present moment indicates that the presence of sulphuric acid slightly raises the surface tension of water, but only very slightly up to a 10% solution of the acid in water. Have I answered the question:

THE WITNESS: Mr. Williams, may I supplement that statement with one reference?

X-Q. 119. Certainly.

A. I would like to call your attention to Figure 140, page 74, of Freundlich Kapillar Chemie in which the course of the curve, indicating the effect of sulphuric acid on water, is given. The ordinates being the numerical value of the surface tension and the abscissae, percentage of water and acid.

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X-Q. 120. And what, in general, does this table show?

A. That with pure water the tension is a little over 75 dynes and as the quantity of sulphuric acid is raised say, to about 8% which is the first point on the curve, the rise is practically horizontal, indicates no very sensible apparent change. After that, up to about 50% solution, the surface tension is raised to a value a trifle over 79, and after that the higher the concentration of acid, the surface tension seems to fall.

X-Q. 121. So that the more concentrated acid has the lowest surface tension; is that right?

A. That is as I understand the diagram which he has given here. I have not studied this diagram, it has only recently been called to my attention, but I mentioned that to indicate that the rise with small quantities of acid is almost negligible.

MR. WILLIAMS: I think I would like to offer in evidence a copy of this diagram and I will have the copy made. (Page 74, Figure 14c.)

The diagram was admitted in evidence without objection and marked PLAINTIFF'S EXHIBIT 143.

THE WITNESS: May I supplement my statement with a still further remark? That variation of surface tension indicated in this diagram with a concentrate of sulphuric acid is far smaller than the variation between the different measured values which we have already

quoted for water carrying from 71.7, lowest value, to 76.8, the highest value. The variation there is over 6% between the different determinations of surface tension of water.

X-Q. 122. Is there a selective action of the air in water as between metal and gangue?

A. I don't think I understand your question. I don't understand how air can be in water.

X-Q. 123. Well, you may have a bubble of air in water. That is, I take it, the easiest way to put air in water.

A. Well, please restate the question, introducing the bubble.

X-Q. 124. Is there a selective action of bubbles of air in water as between metallic sulphide and gangue?

MR. SHERIDAN: I would like to have the counsel state whether he means pure, uncontaminated water, because water varies in various sections of the country.

THE COURT: This gentleman is an expert on this question. In his answer he may qualify it or illustrate it or draw the distinction.

A. The condition which you have stated is a rather complex one and I do not feel that I can answer it unless I were to represent to my eye the conditions that you have in mind as to how the bubble is placed with respect to the material. I don't fully grasp the point of the question. I may say this, that as far as I do understand the question, that air is differently absorbed at different surfaces. If you have a piece of sulphide

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in air, there will be a different adsorption of air possibly on the sulphide from what there will be on the quartz. Now, if that is introduced into water the water may displace one of these adsorbed layers more readily from one surface than from the other. But what condition of thing you contemplate as to the position of the bubble of air with respect to the sulphide I do not quite understand.

X-Q. 125. Assume a particle of sulphide immersed in water resting upon the bottom. Assume a bubble of air presented to the bare surface of this sulphide particle by being pushed down to it. What will happen when you, after making a good contact between the bubble and the metal, permit the bubble to rise?

A. May I answer that by a diagram?

X-Q. 126. Certainly.

A. (The witness draws a diagram.) Have I correctly apprehended the circumstances you have in mind?

X-Q. 127. Yes, your sketch represents the condition, and here is a bubble attached to a bubble holder. The bubble of air is brought down and touched to the clean sulphide.

A. Under these circumstances I am of the opinion that this angle of repose, as I have called it, would be essentially the same as the angle that would be made by a drop against the sulphide surface. That is, the angle between the air-water surface and the sulphide-water surface. This is the angle here between the air-water surface and the sulphide water surface.

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X-Q. 128. Now, what would happen if the bubble holder were lifted upwards?

A. The force of surface tension has a certain component. If the particle of sulphide were greater than the total value of the upward pull of surface tension it would not be lifted from the bottom but the bubble would stretch out and would finally neck off, and we should have a complete spherical bubble attached to the bubble holder and probably a little watch-glass bubble attached to the surface, in case the sulphide was too heavy. If the sulphide particle was not, then I should expect that the bubble would lift to the surface through the water.

X-Q. 129. And if the weight of the sulphide particle as immersed in water was less than the buoyancy of the air bubble, the air bubble would lift the metallic particle; is that correct?

A. I think it might. I wish to correct my former statement about what would happen to this bubble. There is another possibility: If the sulphide were too heavy and the bubble holder were lifted this bubble would stretch out in a cylindrical form. The diameter here would become less and it is just possible that the water would creep in from each side until it was detached. That is another possibility. I have not tried the experiment and I can not swear from observation.

X-Q. 130. Now, the purpose of my inquiry was to bring about some explanation as to the selective action of air bubbles. Now, what would happen if there

was a substitution of gangue for clean sulphide, clean gangue; other conditions remaining the same?

A. A drop of water put upon clean gangue makes a very small flat shape; it spreads out; the angle of contact is very small, and I apprehend that this angle there would be the same as the angle of the tangent there, and there would be a slighter attachment of the air to the gangue than with the sulphide.

X-Q. 131. In consequence of that you would expect that the bubble, by its buoyancy would exercise very little lifting power upon the gangue particle?

A. I would, provided, of course, always, that these surfaces are not contaminated with oil. This is a clean sulphide, no oil present, and clean gangue, no oil present. Would you like me to tell what happens when there is oil there?

X-Q. 132. Yes, suppose you tell us what would happen with oil.

A. I will have to draw another diagram—

(Last diagram marked "Beach diagram No. 17).

MR. SHERIDAN: I offer diagram No. 17 in evidence.

> Diagram admitted in evidence without objection and marked DEFENDANT'S EXHIBIT No. 144.

THE WITNESS: Let this represent the surface of sulphide, oiled. Suppose that I moisten my finger slightly with oil and rub it over the surface, and I

put upon that surface a drop of water. The drop of water, instead of standing up in a large heap, will flatten out so as to make a much smaller angle than that shown in the preceding figure. With the bubble holder the attachment of the air to the sulphide surface will now make a small angle. I have a note book full of measurements, made upon that. It is far less than upon clean sulphide. The clean sulphide is somewhere from 80° or 90° minimum, and when I use oil it sinks down to 25° or 30°, and we have here a condition such as if—such that if you begin to lift on that, this part here will run over those oil surfaces; its interfacial surface having been diminished, and the particle will not be raised. I would like to state that I tried out that theory thoroughly, and found that it was insufficient. The moment that I saw a flotation machine in operation I rejected the idea that the particles of sulphide were lifted by the minute bubbles attached to the particles.

X-Q. 133. I will ask you to sketch on that sheet this: suppose that you have sulphide mineral, clean, and water containing soluble frothing agent dissolved in it, what will be the condition?

A. (Drawing) I am representing there a drop of this water with the contaminant, the same as with the pure water.

X-Q. 134. Are you assuming any particular contaminant?

A. I understood you to say a soluble contaminant.

X-Q. 135. A soluble frothing agent. Take acetic acid, for instance?

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A. Do you object to the use of the word "contaminant"?

X-Q. 136. Well, it must be a frothing agent?

A. I don't know what you mean by a frothing agent.

X-Q. 137. Phenol, creosote, acetic acid, amyl acetate, whiskey, valerianic acid—there is a long list of them?

A. I think we could find experimentally what would happen by using a drop of this water with a frothing agent, putting it on the clean sulphide surface and observing that angle. The substances which you have named I have not personally tried. I believe that most of those, as I remember your naming them over, have the effect of reducing the surface tension.

X-Q. 138. That is right.

A. It is my opinion that the effect of these contaminants or soluble frothing agents is to reduce that interfacial tension, and to allow the drop to spread out flat. It can be tried. I have not personally tried it in the case of these substances. I have tried it with sulphuric acid, and in our experiments with sulphuric acid I found the increase here—I am quoting from memory, but to the best of my recollection and belief—I cannot say that there were any exceptions—I will say this, in the majority of cases I found that the angle of repose was less than in the case of pure water, and therefore when we come to the question of the bubble attachment to the bubble holder—I am now giving my opinion—my opinion is that this angle would be smaller than in

the case of pure water against a sulphide, and that the lifting power of this bubble would be diminished.

(Whereupon a short recess was taken.)

Beach diagram No. 18 admitted in evidence and marked DEFENDANT'S EXHIBIT 145.

X-Q. 139. Now, I would like your explanation, professor, of one other set of conditions. Instead of water, oiled sulphide mineral at the bottom, take the air bubble presented to the sulphide mineral in oil?

A. What are the conditions?

X-Q. 140. Oil; a body of oil, and a bubble lowered in the bubble holder and presented to the sulphide surface as before?

A. I should say that I have not seen or studied this condition, but as a method of investigation it is perfectly general. I should proceed by placing a drop of oil upon the sulphide surface.

X-Q. 141. Which you have done, of course?

A. I have done that, and I know that the angle is small. I have measured a lot of angles, but I have not them with my notes here. The angle of contact between the water-oil surface, and the sulphide surface will be essentially the same here as it was there, and I should expect a very slight attachment of the bubble to the sulphide.

X-Q. 142. You said water; you meant air?

A. Air. Of the air bubbles to the sulphide surface.

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X-Q. 143. And the consequences of that small angle would be what as to the lifting power of the bubble?

A. The air-sulphide interface has a larger amount of surface energy than the oil-sulphide interface. The tendency is for this oil-sulphide area to increase, and the air-sulphide to decrease. Therefore, I should expect, under the disturbances of the original condition, trying to lift it, that the oil would come in from the side, and the bubble would detach itself without causing any sensible lifting power to the sulphide. All these answers have reference to particles of sulphide or quartz that are large compared to the thickness of the adsorbed layer or interface; I was not discussing finely ground ore in any of these cases.

(Diagram last referred to marked Beach diagram No. 19).

Diagram admitted in evidence without objection and marked DEFENDANT'S EXHIBIT No. 146.

X-Q. 144. Now, let us assume all the conditions as in diagram No. 19, except that we have finely powdered sulphide on the bottom of your glass or other vessel filled with oil, and an air bubble carried down by the bubble holder and brought into contact with these very fine particles. What then would happen?

A. I would like to draw a diagram of that to make myself perfectly definite. I understand this was to be in oil?

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X-Q. 145. Yes.

A. This drawing represents the presentation of an air filled cavity in a pool of oil to some sulphide particles which are resting on the bottom of the containing glass vessel. This interface between the air and the oil is undoubtedly the seat of a certain amount of adsorption of air. I have no experimental evidence which would indicate that in the absence of water a sulphide particle has any different potential energy in that air-water interface from what it has in oil. I should expect that some of the sulphide particles might be held up by film flotation on the lower part of the bubble, but I have no experimental data which would enable me to predict, although I think it highly probable that if such a bubble were presented, that the surface energy —the surface tension of this layer is a little different, probably a little less than what it is in the bubble, and I should expect to find some of those particles entangled in that layer, especially as their presence there would increase the viscosity, and if they once touched the interface they would not be readily drawn up from it.

P. 3100, L. 25, insert "at the inside of the bubble, and at metal oil surface" after "surface"

... would depend upon the general adhesive relations of those particular substances, which I have not personally studied. I may say that in general when a particle of a substance gets into an interface, or a number of them get there, they increase the viscosity, and

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it is a little harder to pull them out after they have once been in there; under the influence of the weight of the oil they may get tangled in that viscous interface, and they are not easily removed and shaken off, and I think perhaps the same thing would happen in an air-oil interface in the case you have asked about.

X-Q. 147. You last referred to your test No. 12?

A. Test No. 12, yes.

(Last diagram marked "Beach diagram No. 20).

Diagram admitted in evidence without objection and marked DEFENDANT'S EXHIBIT No. 147.

X-Q. 148. Is there any difference between adhesiveness and adsorption, or in what manner are they related?

A. By adhesion I understand the molecular attraction of the molecule of one substance for the molecule of another substance. They stick together, if we discuss it in terms of forces, but in general I prefer to discuss the thing in terms of energy. The result of the molecular attraction between the molecule of sulphide and the molecule of oil is to concentrate a layer of the substance at the interface, and that layer of transition where the concentration takes place, is called the adsorption layer, and the change in concentration is known as adsorption.

X-Q. 149. Can you give me any dimensions as to

the thickness of the interface where we have a bubble of air immersed in water and containing what you have described as an inner oil layer, I believe?

A. I don't remember using the term, inner oil layer, but to reply to the question as to thickness, I have not any very definite idea; it varies, undoubtedly, with the substance in service.

X-Q. 150. Take, for example, the interface between oil and water of which you have spoken to a considerable extent. Can you give any definite dimensions as to the thickness of that interface?

A. I cannot. It would undoubtedly vary with different oils, and especially with the different solids that happened to be present. In the case of the kerosene and the inky water, that film—I don't call it an interface—but that adsorption film, I should judge, was smaller than in the case where it was loaded up with metallic particles as in that bottle to which you just referred.

X-Q. 151. Now, let us take the simple case of kerosene oil in contact with water and no metallic particles?

A. Yes.

X-Q. 152. Can you give a definite statement as to the thickness of that interface?

A. I suppose that it is more than one molecule thick. Whether it is more than 100 molecules thick, I do not know. I am not aware that any experimental investigation or estimation of that thickness has been made.

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X-Q. 153. Now, let us assume an oil-air surface with no metal present. What would be the thickness of the interface?

A. I don't understand that an interface has any thickness. The adsorbed layer has a thickness. I am not aware that any measurement has been made of the thickness of the adsorbed layer or if it has these things are not known to me. They belong to the realm of physical chemistry and that is not my specialty.

X-Q. 154. Well, can you give us any idea of the thickness represented by what you state as the possible maximum in the case of oil and water, 100 molecules?

A. I can't, expressed in centimeters or inches.

X-Q. 155. It is so impossible for the lay mind to think in molecules that I was trying to find out if you, as a physicist might not help us to get a picture of what was described. Can you do so?

A. Well, the picture in my mind is that we have a layer of molecules in the case of the water-kerosene surface—I suppose that some of the water molecules are dispersed or diffused into the kerosene and some of the kerosene molecules are mixed or diffused into the water. In physics, we do not regard absolute discontinuity, and accordingly things shade off gradually, these things are more or less mixed or intermingled at the interface. As to the thickness of it I have no conception.

X-Q. 156. Now, in case of an adsorption layer of an air bubble immersed in water, can you give a picture

of the minimum condition wherein that adsorption layer is one such as you have described, containing oil and shading off into the water?

A. I am not quite sure that I apprehend your question. It is the boundary between water and air, the air being within a cavity and the water surrounding that?

X-Q. 157. And there being an oil adsorption layer at the interface of the oil bubble. In other words, the condition that you found when you have oil present in water and air bubbles in the water—and these air bubbles have met some of the oil?

A. I think, Prof. Taggart drew a diagram yesterday and I will refer to his drawing. If I have correctly apprehended the question, referring to diagram 7 of Prof. Taggart, Defendant's Exhibit, 130, referring to the portion of the diagram lettered A, which I understand to represent a face containing air and this to be an oil contaminated surface, and this to be—

X-Q. 158. (Interrupting) and outside of it, water.

A. Water, possibly containing oil or not, as the case may be, but mostly water. I understand that there is a greater concentration of particles of the oil at the interface, that is, where the air begins, because thereby the oil lowers the surface tension or reduces the potential energy of the system and those particles of oil depending upon its degree of solubility, will shade off very rapidly if it is an insoluble oil, so called, and much more gradually if it is a soluble oil. There is also undoubtedly more or less compression or concentration of the air molecules near that surface. If there is a suf-

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ficient amount of oil present then we may have a pure oil at this surface just as in the case where we put a drop of kerosene on a glass of water and the kerosene spreads over almost indefinitely and makes a layer so thin or so minute that it can only be perceived by special tests. Have I apprehended your question, or answered it?

X-Q. 159. Yes. If we assume what are generally called insoluble oils, can you give any explanation of the minimum condition when there would be a substantial concentration at the interface, that quick shading off that you speak of?

A. The minimum condition, I judge, would be a layer of molecules, one molecule thick. That is the least that I can conceive of.

X-Q. 160. And it is conceivable that there may be such a condition?

A. I think so.

X-Q. 161. That is to say, there is no reason why, under the forces that are at work there, you would not be able to spread out on the interwall of the bubble, a layer of oil one molecule thick?

A. I am not sure that I understand the question, but as I understand it, the least amount of oil which would produce a contaminated surface there having the same properties all over, would be a layer one molecule thick. If we had less than one molecule thick they would be more or less bunched together in some places and scattered out in others and the surface would not have the same properties all over.

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X-Q. 162. Now would such a layer, one molecule thick, be of utility in the concentration of ores?

A. I should not suppose it would for the reason that the particles which are being lifted are of a size very large compared with the dimensions of a molecule.

X-Q. 163. What further additional thickness would alter the condition of the problem?

A. I don't quite know what you mean by "the condition of the problem". Do you mean how thick a layer would be operative?

X-Q. 164. I understood that you said something about the surface energies being unaffected by thickness after a certain minimum thickness had been attained, and I would like to get that minimum thickness that you had in mind.

A. That is not my understanding of the statement. My statement was this: That the surface tension of a liquid film, that is, with an upper and a lower surface, a liquid film does not depend on the thickness as long as that thickness exceeds a certain small value: Do you want that thickness?

X-Q. 165. Yes.

A. I can only quote that from memory as I haven't my notes with me. I have represented here (drawing a diagram on paper); a molecule of any substance and here is another molecule of the same substance. Then, the limit of molecular range, I mean the greatest distance which we can separate these molecules and still have this one act upon that, that distance, d, is, I be-

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lieve, 1/20,000 m.m. Liquid films, soap films have been measured which are considerably thinner than that. By "considerably" half or a quarter. The soap film ceases to show the ordinary colors and becomes dark. That is called the black spot. The thickness of the black spot, I believe, is quite a little less than that. The number I cannot recall at the moment, but if it is thinned out beyond that thickness that film changes its properties in rather an erratic way, and if it is much thinner than that undoubtedly it breaks, but I am unable to quote from memory and I have not sufficient data here to specify that.

X-Q. 166. Have you made any such investigation as to the film obtained in the agitation of froth flotation process?

A. As to the minimum film?

X-Q. 167. Yes.

A. No.

X-Q. 168. You have no measurements?

A. I have no measurements of their thickness. When they are loaded with these metallic particles as in the flotation process they undoubtedly have a thickness which is not of ultra-microscopic character, but a sensible fraction of a millimeter. I mean the whole thing, including the mineral particles which are imbedded in it.

X-Q. 169. There must be, I take it, a sensible difference in the thickness of the adsorption layer around an air bubble when it emerges from a liquid as con-

trasted with the adsorption layer when it is immersed in the liquid? Is that true?

A. It has a single adsorption layer when it is in the liquid and when it emerges it has a double adsorption layer, one inside and one outside, the thickness of that film being dependent on the metallic load which it carries. And it would—

X-Q. 170. And it would have a definite relation to the thickness of the adsorbed layer of the immersed bubble?

A. I don't think so.

X-Q. 171. Would it be thicker of necessity?

A. Because there are two adsorption layers, I should think it would.

X-Q. 172. Can you give me any definite idea of the thickness of the adsorption layer of contaminated immersed air bubbles in the absence of solid particles in the bubbles?

A. Such information is not within my memory. It is possible that the physical chemists have made such measurements but I can not supply them at the present moment.

X-Q. 173. And as to the thickness of the double adsorption layer or film of the bubble, that has emerged from the water, can you give me anything definite as to that?

A. Why, it may be something in my judgment a quarter as large as that that I have written on the blackboard and it may be anything above that. I do not know that there is any special limit. In the kind of

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phenomena which we had in this experiment No. 7, the thickness of these colored water globules could be anything. The interface there was air, in that particular case, was an air water interface; and the outer surface in that case was an oil-water interface, and the thickness between them as we observed it, might be anything over a millimeter.

X-Q. 174. I would like a definite statement from you as to whether or not the affinity of air for metal is utilized in the froth flotation concentration of ore.

A. In the agitation froth process, or in the pneumatic froth process, is it not. It is not, except in as far as there may be air adsorption in this interface.

X-Q. 175. That is, there may be air adsorbed at the oil-adsorption interface?

A. There may be air adsorbed at any place where air is in contact with another liquid or another solid, but in my judgment, air plays a relatively insignificant part.

X-Q. 176. Now, it is true, it it not, that where you employ oil in the concentration of ores, varied in the procedure of agitation froth flotation or pneumatic froth flotation, that there is an amount of oil so small that you get no practical results at all from it? That is true, isn't it?

A. If I understand the question, no. Will you please repeat it?

(Question read.)

A. Now, I understand if there is any oil present at

all that it has some influence in forming these contamination layers and it acts in the process.

X-Q. 177. Well, it is a fact, is it not, that you can use too little oil to get any practical result at all?

A. It is all a question of degree, a question of the stability of the film that you get. The actual operation of the mills or the cells, I am not competent to discuss. I would give it as my opinion that the difference between a minute quantity of oil and a large quantity of oil is wholly a question of degree and not a question of difference in kind.

X-Q. 178. Well, now, I am assuming something more minute than the minute quantity of oil. Conceding that, you can get no practical results at all; isn't that so?

A. I don't understand what you mean "assuming something more minute than a minute quantity." Would you put that in figures?

X-Q. 179. I understood when you said "minute quantity of oil" you referred to the minimum quantity of oil that was used and produced useful results. Now, I say if you go down below that you impair your results, do you not?

A. That is a question of technical operation of which I have no adequate knowledge.

X-Q. 180. Now, let us assume that you had one drop of oil to ten tons of water, and suppose you undertook to impregnate that water with little air bubbles by sending the bubbles up through a porous bottom. What would you expect to be the result of that

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one drop of oil in that ten tons of water upon the millions and millions of air bubbles that would be distributed through the mass?

A. I would expect that this oil would adsorb in the air-water surface of some of the bubbles which it first met. It might distribute itself in one bubble or it might distribute itself in a thousand bubbles; and if any one of these bubbles came in contact with a sulphide particle, it might pick up one sulphide particle. Whether that is a commercial operation or not I am not qualified to say.

X-Q. 181. Now, let us start with an ore pulp, and in that ore pulp we have a drop of oil, and ten tons of ore and twenty tons of water, and we agitate that very vigorously, and then we pass it into spitzkastens. We use every possible effort to thoroughly disseminate that oil through the pulp and bring it in contact with metallic particles; what would you expect to happen under those conditions?

A. If I had apparatus sufficiently delicate I should expect to find some air-water surfaces and possibly bubbles which were contaminated with the oil, and possibly a particle or two of sulphide imbedded in it; but it is a needle lost in a haystack.

X-Q. 182. Now, isn't it conceivable that there is some point at which—some point in the oil quantity or degree of oil quantity at which, when added to that pulp, we bring about the concentration in a froth of the maximum number of sulphide particles?

A. No, not a maximum. If the first condition raised one sulphide particle, and you doubled it, you might get two; if you trebled it you might get three. The thing would appeal to me as a matter of degree. I know of absolutely no dividing line, no critical point of change.

X-Q. 183. But isn't it true that you have got a certain number of sulphide particles in your pulp; you have a certain definite number of sulphide particles in your pulp?

A. Yes.

X-Q. 184. I am assuming all other conditions equal, and I am merely adding oil enough to get, say, ninety per cent of the sulphide particles in that pulp to the surface in the form of froth. Isn't it conceivable that there is a certain quantity of oil that will do that?

A. A certain quantity—depending on what is sufficient to do it?

X-Q. 185. Yes.

A. I suppose it is, but I also suppose that if you attach a little more oil, it will do it just as well or a little better.

X-Q. 186. Now, I am assuming that keeping the conditions equal you have found out just how much oil will do it. Now, do you say that having added a little more oil it will do it better—I can't understand that? After a thing is done it is done. If you will explain, I will try to understand it?

A. Well, by doing it better I mean hold them more securely, make a more stable froth, less likely to escape

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from it, bring it up more readily; it may take longer agitation with a minute quantity of oil than with a larger quantity of oil.

X-Q. 187. Then you think the addition of oil will make for the stability of the froth—the addition of the oil beyond what is necessary to bring them up will make for the stability of the froth, is that correct?

A. As I understand the conditions which are proposed, if we had a film which contained a very sparse layer of metallic particles, the viscosity would be relatively small. If we use more oil, that oil would adsorb upon those particles and more of them would stick to it, and the resulting bubble film would be more stable and more persistent.

X-Q. 188. Then there would be a certain oil proportion by the use of which you would get a certain best condition of stability?

A. I don't know what you mean by best condition.

X-Q. 189. Suppose we start with a certain pulp containing a certain number of metallic particles, and you put in oil and put it through the process, and we find that we have not enough oil to give us what we want; the froth of that certain stability containing a certain number of metallic particles. If we had a little more oil we would approach the condition that we want, wouldn't we?

A. I don't know. I suppose you would bring out more particles and you would get a more stable froth.

X-Q. 190. And there must be some condition when we get the maximum froth?

A. No, I don't think so.

X-Q. 191. You cannot conceive it?

A. I don't see any condition of maximum.

X-Q. 192. And the more oil you put in the better the results is that right?

A. You will ultimately arrive at bulk oil flotation. You would not have bubbles if you put in oil enough.

X-Q. 193. How much do you know of bulk oil flotation?

A. I will answer again that I am not an expert in technical matters, and I am not competent to answer that question? I don't know.

X-Q. 194. Can you conceive a condition where, having started with a certain pulp and added to it a certain amount of oil, enough to form a good froth containing ninety per cent of your concentrate, with that definite relation, and now you add a little more oil. What do you expect to happen then?

A. I suppose you might get a thicker froth, a froth which looked more oily, which might hold more oil than was absolutely essential, a non-economical use of the oil, some of which might be redundant, but as I stated, I don't feel that my opinion is competent, because I am not an expert in the actual operation. I am only stating my idea of what might happen; in other words, if I apprehend your question, there is an amount of oil, undoubtedly, that is too small to get any discoverable effect. One molecule of oil won't form an adsorptive layer, but I don't think that there is any maxi-

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mum there at which the flotation process would cease, before you get to bulk oil flotation.

X-Q. 195. How about a minimum amount of oil?

A. One molecule.

X-Q. 196. One molecule, you mean a layer of one molecule over every bubble?

P. 3115, L. 9, cancel "over every bubble" and insert "of oil might attach itself to the ore molecule of" after "molecule"

come to the surface.

X-Q. 197. That would not be a practical process of concentrating ores?

A. No.

X-Q. 198. Now, let us get up to a practical process; can you give any opinion as to the practical processes of concentrating ores?

A. No, I don't know anything about the practice of concentrating. I am, however, sure that there is no dividing line in the amount of flotation. There may be different amounts of froths—different kinds of froths, some more stable and some less stable, some richer and some poorer, but that is a question for the experts in manipulation and is outside of my field. I have endeavored to explain how the thing occurs. The conditions under which it is to be carried out I don't know.

X-Q. 199. Therefore your statements that there is no critical point is a statement based upon theory and not upon actual knowledge of the practice of the process?

A. By the word "theory" I do not mean hypothesis. In answering that question when I use the word theory I mean a set of conclusions drawn from certain premises, experimentally established, these conclusions being reasoned out. My opinion is based upon theory as so explained, and my answer as given is in accordance with that.

X-Q. 199½. Suppose I put a case to you of using one-tenth of one per cent of oil to the ore, and obtaining by it a concentrate of high grade with a ninety per cent recovery; that would be a practical process of concentrating ores, wouldn't it?

A. Why, I have heard it so stated; I don't know of the actual operation myself.

X-Q. 200. Now, if you added two-tenths of one per cent, you would be using more oil than would be necessary, wouldn't you?

A. I judge not, from the testimony of the experts.

X-Q. 201. From what testimony?

A. I understood Mr. Wickes to say that in many cases the use of a larger quantity of oil was very beneficial to the commercial results.

X-Q. 202. Then you base it upon what has been said here about these wonderful operations, aiming to use twenty pounds of oil or more to the ton of ore?

A. No, I base it on my understanding of what actually happens in the flotation cell.

X-Q. 203. Well, let us put it this way. Suppose you get a ninety-five per cent recovery with a high grade, and one-tenth of one per cent, or two pounds of oil to

the ton of ore. Suppose you increase it to twenty pounds to the ton of ore and get the same grade and the same recovery. Is it your theory, that, comparing those two operations, the one using two pounds and the other using twenty pounds, and both getting the same results, that those operations are essentially and in all respects the same?

A. I would not say that the result was the same in every respect, but I would say that the process was the same in kind. It is the process that I am describing, and not the result.

X-Q. 204. Would the concentrate froth be substantially the same?

A. There would be probably differences in the amount of oil detectable in the—on the surface.

X-Q. 205. Most of the oil would go with the concentrate, would it?

A. That depends how much water there was and how much agitation was used and how much mineral was there.

X-Q. 206. Let us take the case of two pounds.

MR. SHERIDAN: I object, because the witness has not qualified as a practical mill operator. I have listened to it a long time. He is not a mill operator at all, and has not testified to mill operations, but simply to the physics of the phenomena.

THE COURT: I think so. He has assumed to testify how the process worked and the functions of these various materials used in it, but nothing—

MR. WILLIAMS: I respectfully submit that the witness has said that there is no such thing as a critical point, and that he has testified as to the process of concentrating ores. Consequently I am entitled to inquire rather fully as to that matter.

THE COURT: Well, proceed; we will see what the question is.

X-Q. 207. Take the case of two pounds of oil to the ton of ore, where would you find the oil at the conclusion of the operation?

A. I don't know what the operation is that you contemplate.

X-Q. 208. The operation of froth flotation concentration of ores; the agitation froth process or the pneumatic?

A. Again I say that I am not familiar with all the details of this operation. I don't know what becomes of the tailings or what water is spilled or the various cells that carry the circulating load; I am not competent to answer that question; I don't know.

X-Q. 209. Now, the case—take the case of a soluble frothing agent. This soluble frothing agent being dissolved in the ore pulp, is wholly distributed through the pulp, is it not, primarily?

A. That depends what degree of solution you use?

X-Q. 210. Well, it is wholly dissolved; I am talking of it as a dissolved substance in the pulp?

A. Well, soluble substances do not dissolve without limit; there is a limit to solution, and the thing may be saturated and nothing may be dissolved.

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X-Q. 211. I did not say soluble without the further qualification that it was wholly dissolved. Now we have dissolved in the pulp a frothing agent?

A. Do you mean dissolved in the water of the pulp?

X-Q. 212. Dissolved in the water of the pulp if you will, a frothing agent?

A. Yes.

X-Q. 213. Now, that is distributed uniformly through the pulp, is it not?

A. I don't know.

X-Q. 214. Now, let us assume that you put in a soluble frothing agent and put it through the Janney emulsifiers, or the first agitator, then let it flow into the separation box or spitzkasten. That operation has brought about, has it not, the contact of every metal particle with the water containing the dissolved frothing agent?

A. I presume so; I don't know; I never watched it.

X-Q. 215. If a particle of metal is in the water of that pulp containing a dissolved frothing agent distributed and dissolved in it, must it not be in contact with the water containing the dissolved frothing agent?

A. And no other oil or insoluble oil present?

X-Q. 216. Yes.

A. I presume it would be.

X-Q. 217. And has every bubble of air in that pulp not also come in contact with water containing the dissolved frothing agent?

A. I think it would depend somewhat upon the character of the frothing agent.

X-Q. 218. I am assuming a wholly dissolved frothing agent dissolved through the pulp. Now, I ask you if the air bubbles will not of necessity be in contact?

A. It would make a difference, it seems to me, whether the soluble frothing agent lowers the surface tension or raises the surface tension.

X-Q. 219. I see—I think we have got far enough along to know that the soluble frothing agent, if a soluble frothing agent has to lower the surface tension, haven't we?

A. No.

X-Q. 220. You have not reached that point yet?

A. No.

X-Q. 221. Well, let us take a soluble frothing agent that does lower the surface tension, if you wish me to put that as a qualification. Won't every air bubble be in contact, that is immersed in the pulp—be in contact with the water containing this dissolved frothing agent?

A. I am not sure. My opinion is it would depend on the character of the frothing agent, on the amount of the energy of the various interfaces.

X-Q. 222. And when you get your concentrate with this dissolved frothing agent, where would you expect to find the dissolved frothing agent? You have floated off your froth and separated it, and you have in your spitzkasten the tailings—where will you find your dissolved frothing agent?

A. I am not even sure that this dissolved frothing agent would collect the mineral particles. You have

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got to specify the character of the frothing agent, whether it has any adhesion to the sulphide. All that has been said in my understanding of the question was that this substance was soluble in water and it produced a froth. Now, I am not sure that the sulphide will tend to migrate into these bubble films any more than the quartz does. We have got to study the character of the particular kind of frothing agent.

X-Q. 223. Well, take acetic acid?

A. I don't know anything about that, but if you will permit me to specify another case, the case of saponin. If saponin is put in water it lowers the surface tension slightly with increased viscosity, and you get a very nice froth, but there is no essential adhesion between the sulphide and the saponin. A frothing agent like saponin does not, as I understand it, produce mineral separation of this kind.

X-Q. 224. I see you have not adopted the terminology of the art—that is, the terminology of the art in the patents at least, that is a mineral frothing agent, and I intended always to describe a mineral frothing agent, a frothing agent that produced a selective mineral froth or selective froth?

A. In the case that you get a froth by such frothing agent, if you examine the froth or the concentrate as it comes up in the froth, I should expect to find a very considerable part of it in that interfacial film.

X-Q. 225. And the concentrate would carry a great part of the dissolved mineral frothing agent?

A. I think so.

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X-Q. 226. And the operation of the process would have robbed the pulp, you might say, of its dissolved frothing agent?

A. To a certain extent.

X-Q. 227. You don't know to what extent?

A. I don't know to what extent. That is entirely outside of my field of investigation.

X-Q. 228. Now, in your direct examination you said that in the agitation froth process of concentrating ores, oil above one per cent and oil under one per cent were the same, but you just made the bare statement. Now, I would like you to put as fully and clearly as you can, your reason for that statement?

A. Well, in the theory in which I have outlined with the physical facts and principles to which we appeal in explanation thereof, I see absolutely no difference in the process of the operation.

X-Q. 229. You recognize, as I understand it then, no difference in the process from a minimum of something less than a pound of oil to the ton of ore, up to the conditions of 200 pounds of oil to the ton of ore?

A. I can see no difference in the physical phenomena nor reason for a failure of the process.

X-Q. 230. With 200 pounds to the tone of ore, would you expect to find that your froth was composed of air bubbles, and metal particles exclusively?

A. I have never seen cell operations with such large amounts of oil and I have no idea what would happen.

X-Q. 231. What is the largest amount you have seen?

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A. I do not know. The amounts were not told me.

X-Q. 232. What is the smallest amount you have seen?

A. You mean in mill operations?

X-Q. 233. In mill operations.

A. The facts were not told me. I simply saw the machines operating.

X-Q. 234. Your practical contact with mill operations has extended over what period?

A. It hasn't any extent. I have seen mills in operation, but I have no acquaintance and no competency to pass upon their operations.

X-Q. 235. Can you conceive of a bulk oil float buoyed by air bubbles in it, like a sponge? Can you conceive of that as being produced by the use of oil, ore and water?

A. I never have seen the bulk oil operation and I am not able to answer that question.

X-Q. 236. Can you give any theory as to the relation of the metal particles in such a bulk oil float, to the air bubbles in that float?

A. All I can state is that the metallic or solid particles would take up that position where their potential energy was least, and that can only be determined by experimental investigation. I think the chances are that if they were to reach the air-oil viscous layer, that they might have some difficulty in leaving it? But, further than that, I have not made any investigation on that point. I can not offer any intelligent opinion.

X-Q. 237. Would the air bubble in that oil layer

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loaded with metallic particles per form any useful function other than to make a hole and diminish its weight?

A. I can not say; I have not seen it.

X-Q. 238. Have you ever seen a float wherein there were oil bubbles and air bubbles, the oil bubbles and air bubbles existing in what looked like a froth but was not in fact an air ~~ore~~ froth?

A. I don't understand what you mean by an air bubble, or what by an oil bubble. What is the air bubble made of?

X-Q. 239. The air bubble has a film about it.

A. Film of what?

X-Q. 240. A film which I would say would contain some oil, and have you ever seen in the same float with that, an oil bubble?

A. I don't understand what an oil bubble is; how is that different from the so-called air bubble?

X-Q. 241. Is it conceivable that there could be an oil globule in such a float?

A. A body of oil—a globule of oil might be surrounded with water.—

X-Q. 242. Well, now, that is a float where you have these floating bubbles with their oil adsorbed layer, and metal particles? Have you seen in such a float globules of oil?

A. No.

X-Q. 243. Never?

A. No.

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X-Q. 244. But I take it that your examination of what has been done in mill operations has been of such a recent nature that you really would not express an opinion?

A. I am not competent to pass upon mill operations of any sort or character.

Whereupon an adjournment was taken until Friday, April 27, 1917.

Friday, April 27, 1917, 10:00 A. M.

FREDERICK E. BEACH resumed the stand for further

CROSS-EXAMINATION

BY MR. WILLIAMS:

X-Q. 245. Coming now, professor, to the scientific viewpoint, is it not scientifically certain that in the agitation process there may be an amount of oil so small that the process will not succeed?

A. I do not grasp all the question. Will the reporter please repeat it?

(Question read as follows: "Coming now, professor, to the scientific viewpoint, is it not scientifically certain that in the agitation process there may be an amount of oil so small that the process will not succeed?")

A. I don't think that I could specify any quantity of oil so small that it could not be conceded to exert

some influence in bringing a sulphide particle to the surface in connection with an air bubble. I presume that there are quantities small enough so that the process would not be commercially acceptable.

X-Q. 246. I will repeat the question: "Coming now, professor, to the scientific viewpoint, is it not scientifically certain that in the agitation process there may be an amount of oil so small that the process will not succeed?"

A. I have tried to answer the question as I understand it, that no matter how small the quantity of oil, the smallest quantity that I can conceive will be a molecule. Now, a molecule of oil might attach itself to a molecule of sulphide in this combination, namely an oiled sulphide particle might be entrapped in a bubble form and brought to the surface. Such a thing, scientifically, it seems to me is possible, but I repeat there may be a quantity of oil which is not commercially acceptable or useful. If I failed to apprehend your question will you please put it differently?

X-Q. 247. Is it not scientifically certain that there must be under a given set of conditions other than the oil proportion, an amount of oil so small that a desired proportion of sulphide particles will not be included in the froth?

A. I understand that "desired proportions" have nothing to do with science. Science inquires as to what can or does happen. "Desired proportions" have to do with commercial values. I have tried to answer the question as I understand it. There is no minimum limit

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down to the molecule of the quantity of oil that I can see that would fail to operate. Whether this amount as small as a molecule of sulphide is desired or not hasn't anything to do with science.

X-Q. 248. I will repeat the question, changing the word "desired" to "fixed"?

(Question read as follows: "Is it not scientifically certain that there must be under a given set of conditions other than the oil proportion, an amount of oil so small that a fixed proportion of sulphide particles will not be included in the froth?")

A. If we mean by "fixed" always under a like condition as far as we can produce it, that the same amount shall always be brought up, I should say that there would be, according to the theory of probability, sometimes more or sometimes less; but I cannot say that I see there should be any minimum limit to the quantity of oil fixed in any way than by the least quantity of oil known to science, namely a molecule.

X-Q. 249. Is it not scientifically certain that there must be under a given set of conditions other than the amount of oil, an amount of oil so large that the process won't succeed?

A. What do you mean by the "process?"

X-Q. 250. The agitation froth process.

A. The agitation froth process in mill operations I am not competent to answer.

X-Q. 250½. I asked you about it scientifically. I didn't say anything about mill operations. I asked you for scientific facts.

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A. But you couple with it, as I understand it, a particular process which is a mill process. That process I am not familiar with.

X-Q. 251. You have testified about the agitation froth proocess from a scientific viewpoint, have you not?

A. Yes, but that process involved the beating of air into a mixture of oil and water and sulphide and gangue. The physical phenomena, physical result, of the process involved in that I have testified to. If by the word "process" you mean such an operation, I can say that I see no limit to the amount of oil which would limit the operation of this process which I have outlined, namely the adsorption of a sulphide particle at a surface, or in other words the migration of a sulphide particle into an interfacial film. The point of the question I understand it is the fixed quantity of oil. The quantity of oil which is involved, for example, in that copper powder experiment has nothing to do with the entanglement of the metallic particle. In that experiment there was an inch of oil. The phenomena would have been absolutely the same if there had been a lake of oil a mile deep. I know of no upper limit to the amount of oil. I have tried to answer the question as I understand it.

X-Q. 252. When you say the process is the same from a molecule of oil upwards is it your theory that, given the presence in water of the minimum quantity necessary to act in the way you have described, and given the necessary agitation and other conditions, it

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acts that way whether an excess of oil over and above that minimum be present or not present?

A. Well, I will try to answer the question as I understood you to put it. It is rather involved. If you have a molecule of oil and a molecule of sulphide, there are certain physical or if you prefer to call it chemical forces of attraction between those. The molecule of sulphide is drawn to the molecule of oil, or vice versa, and there is an adhesion or attachment between them, and they rise together, entangled in the film of an air bubble. I say that the operation of that law or that physical phenomenon is identically the same whether the number of molecules there is one of each, or whether the number of molecules of sulphide and oil are inconceivably great—infinite in number.

MR. WILLIAMS: That is all.

REDIRECT EXAMINATION.

BY MR. SCOTT:

R-Q. 253. When an air bubble in the bubble holder is brought in contact with an oiled-sulphide particle, is there any change in the distribution of the oil—by the bubble holder I refer to this little inverted cup.

A. May I illustrate that by a diagram?

R-Q. 254. Yes.

A. In my sketch let V represent a vessel containing some water as shown, with an upper horizontal surface. Suppose we try an experiment of this sort, that we have a stick of wood, a match stick, or suppose we have a

needle shaped piece of metal or sulphide, that we dip that into the vessel of oil, and when the end of this rod or stick has been oiled that way, present this minute charge of oil to the liquid surface. If this oil was kerosene or creosote or pine oil, at the instant of contact of the oil point with the surface there is usually seen a flash of oil over the surface—seen by reflected light you get the colors of thin films; the experiment is readily visible in that form. Note the condition; we have air on one side of the surface, the interface; we have water below and an oiled stick is brought in contact with that interface. Now, Mr. Scott, I understand that your question conceives a state of circumstances which do not essentially differ in their nature from this. I will try to represent that. Let U represent a glass vessel, and let this represent an oiled sulphide particle or particles which is underneath the surface of the water in this vessel. Suppose that you have a bubble holder such as was discussed in our testimony yesterday, and suppose that you have a bubble there filled with air; we have air on the inside, we have the interface air-water, and we have water. We are now bringing an oiled body in contact with an air-water layer. As far as the physical phenomena are concerned, the conditions are identically the same as they were here; air, water and oiled stick or particle, material of any kind. The physical phenomenon which happens there is a spreading or adsorption of the oil over the interface, and I have no question that there is a layer of adsorbed oil upon the interface of that bubble, just

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as here we find that when the experiment was completed we have an oiled layer or adsorption film in the upper figure. Have I answered the question that you asked?

R-Q. 255. I think so. That will be all.

Diagram marked No. 21 and offered in evidence admitted without objection marked DEFENDANT'S EXHIBIT No. 148.

RECROSS-EXAMINATION.

BY MR. WILLIAMS:

RX-Q. 256. What is the thickness of the film which flashes over the water surface when the water surface or bubble surface meets oil as shown in your diagram?

A. I can not quote the figure, but I can quote from memory an authority in which you can find the statement of the measure value. In the popular lectures by Sir William Thompson, he was Sir William Thompson when the lectures were delivered; he has been since known as Lord Kelvin—and in, I think the first volume —I believe there are three volumes; one of the volumes has to do with geology, and one with navigation, and the first one has to do with certain phenomena of physics. I can not quite recall that, but I am pretty sure it is in the first volume of his popular lectures, that in one of those lectures he discusses the minimum thickness of a layer of oil which will respond to the camphor test. In an experiment of this sort, if you take perfectly clear water and drop on it little grains or dust

of camphor, those particles are seen to move and dance around in a very erratic manner. A minute amount of oil will prevent the camphor from dissolving in the water, and the particles will be then at rest. In that lecture he has carried out a calculation to show what the least thickness might be. The upper limit, the maximum thickness there one can hardly state. If you put on a large drop of oil, a certain amount of it spreads over the surface, and the rest of it gathers together in a little lens-shaped figure, and if you add more oil the lens increases its diameter, until the whole surface would finally become covered to any depth. There is no upper limit, but the smallest thickness that will respond to the camphor test can be found in that lecture. That is my recollection of one instance in the literature of physics that a definite statement is made in regard to the thickness of the oil.

PROFESSOR WILDER D. BANCROFT, called as a witness in behalf of the defendant, being first duly sworn, testified as follows:

DIRECT EXAMINATION.

BY MR. SCOTT:

Q. 1. Professor Bancroft, will you please state your full name?

A. Wilder D. Bancroft.

Q. 2. I will ask you to state the character and nature of your education along scientific subjects?

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A. I have received an A. B. degree in Harvard in 1888. The next year I was assistant in general chemistry and also private assistant to Professor Jackson, doing research work in organic chemistry. The year after, 1889 to 1890, I did research work in organic chemistry at the University of Strasb~~e~~urg, working under Professor Fittig. From 1890 to 1892 I studied physical chemistry at the University of Leipsi~~c~~g under Professor Ostwald. I received ~~b~~my Ph. D. degree at Leipsig in 1892. The following winter I spent at the University of Berlin attending lectures on mathematical physics by Professor Helmholtz. In the spring of 1893 I went to Amsterdam and worked for about two months in the private laboratory of Professor Van 't Hoff. The next year, 1893 to 1894, I was an assistant in general chemistry at Harvard and I gave a private course of lectures on physical chemistry on the side. The next year, during Professor Cook~~l~~e's absence, I gave a course of lectures on physical chemistry. I don't remember whether I was an assistant or an instructor that year. It was one or the other. From 1895 to the present time I have been at Cornell Univeristy as assistant professor of physical chemistry and professor of physical chemistry. I don't remember when I was appointed professor of physical chemistry. It was either in 1902 or 1903. I have had no technical experience.

Q. 3. You have referred to Professor Ostwald and Professor Helmholtz and Professor Van 't Hoff. Can you briefly tell us something about these men, what their line of investigation and authority has been?

A. Ostwald was the man who really developed the modern physical chemistry. He founded the Zeitschrift fuer physikalische Chemie.

THE COURT: What is the name of that?

A. It would be in English the Journal of Physical Chemistry, but I cannot call it that because that is my journal. And he has been the leading figure in the development of physical chemistry. He received the Nobel prize for his work on reactions, velocity and catalysis. I don't know what year he received it. Is that enough about him?

Q. 4. That is all concerning Professor Ostwald?

A. Yes. Helmholtz was an authority on everything. That describes him pretty thoroughly, I think. He began by doing work on the conservation of energy. He and Lord Kelvin were unquestionably the leading two physicists of their time. It is a matter of personal preference which you consider the greater. And he also did an immense amount of work in physiological optics and music and heaven knows what else. Van 't Hoff was the first man to do very much in the way of applying mathematical formulae to reaction velocities. His early work was in organic chemistry, where he developed the theory of the asymmetric carbon atom, which accounted for the optical rotation of carbon compounds. For the greater period of his life he was at Amsterdam. After that he was called to Berlin by the joint action, as I understand it, of the Prussian government and the Prussian Academy of Sciences, a thing which has never happened to any man before in

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the world. When the Nobel prizes were given he was the first man to receive the prize in chemistry.

Q. 5. Have you been connected with any scientific organization?

A. Yes. I am a life member and an ex-president of the American Chemical Society. I was one of the original committee which organized the American Electro-Chemical Society. I am a member of that society and an ex-president. I am a member of the American Physical Society; I am a non-resident member of the American Academy of Arts and Sciences. I am an ex-vice-president of the American Association for the Advancement of Science, section C; I am a member of the Chemist Club of New York and an ex-non-resident vice-president. I founded the Journal of Physical Chemistry in 1896, and I have consequently been the editor of it ever since. I am associate editor of the Journal of the Franklin Institute. I was a member of the executive committee of the Eighth International Congress of Applied Chemistry. I was also chairman of the section on photography and photo-chemistry of the Eighth Congress of Applied Chemistry, and I am now the chairman of the sub-committee on electro-chemistry of the National Research Council in connection with the war.

Q. 6. How long, Professor Bancroft, have you been interested in the subject of flotation concentration?

A. Some time in 1906, presumably in the spring of 1906. I read the articles on the physics of ore flotation by Swinburne and Rudorf and on the concentra-

tion of metalliferous sulphides by flotation by Huntington. I cannot fix the date any more accurately than that because this number of the transactions of the Faraday Society purports to have been published in February, 1906, but these numbers come out at very irregular intervals and I cannot say now, eleven years afterwards, whether it came out in February or whether it came out in August; but I read it as soon as it came and it presumably came in the spring of 1906. At that time I was not lecturing on anything to which these articles had any special application so that they rather went into abeyance, but when I took up a course of lectures on applied colloid chemistry this came in and in the autumn of 1912 I gave a lecture or a part of a lecture on flotation and I have done the same every year since then. In the beginning it was very little knowledge and mostly guess work, and since then there has been every year a little more knowledge and still a great deal of guess work.

Q. 7. Now, how would you define or describe a froth?

A. A froth is a closely packed mass of air bubbles having a honeycomb structure with liquid films as the cell walls and with each individual cell filled with air or with other gas. That definition excludes things like aerated bread which I think should not be considered as froth.

Q. 8. Is it possible to obtain a bubble with a pure liquid?

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A. It is practically impossible to get a free bubble with pure liquid because the surface tension causes the bubble to break.

Q. 9. And what is necessary in order to practically produce a bubble?

A. You ~~might~~ must have in there a third substance which will give a surface film which is more viscous than the mass of the liquid. It may be done then either by concentrating at the surface, which is the usual case, or in special cases by the third substance concentrating in the mass of the liquid, leaving the surface film more dilute.

Q. 10. What substances will concentrate in this way in a surface film?

A. All substances which lower the surface tension of the liquid will concentrate in the surface of the liquid, alcohol and acetic acid, to take two cases, and also any substance which is adsorbed strongly by air.

Q. 11. What effects do alcohol and acetic acid have on the surface tension of water?

A. Both alcohol and acetic acid lower the surface tension of water, and they lower that in all concentration. That is, if you add a little alcohol to water it lowers the surface tension, and as you go on adding more you get the surface tension lower more and more all the way down until you get to pure alcohol. In other words there is no point at which there is either a maximum or a minimum surface tension for any mixture of alcohol and water. The same thing applies for acetic acid and water. That is, we change the—

that is, with changing concentration the surface tension varies continually from the surface tension of pure water to the surface tension of pure alcohol or pure acetic acid, as the case may be.

Q. 12. And what effect does alcohol and acetic acid have on the viscosity of water?

A. The addition of acetic acid increases the viscosity in all particulars with the changing condition of the acid, from the viscosity of pure water, which is less than that of acetic acid, to the viscosity or acetic acid which is greater than that of pure water. Alcohol, however—and by that I mean ethyl-alcohol—behaves quite differently. The first addition of alcohol increases the viscosity of the liquid and further additions increase the viscosity up to a pint—I do not know the exact figure, but approximately 47% alcohol. From that on, the addition of alcohol decreases the viscosity until you get down to the viscosity of pure alcohol. In other words, a concentration which is somewhere about 47 per cent of alcohol, you have a maximum of viscosity and that goes down on the one side to the viscosity of pure water and down on the other side to the viscosity of pure alcohol, so that it is an entirely different question as regards viscosity from the case of acetic acid; whereas, in regard to the surface tension effect the substances behave exactly alike.

Q. 13. What is the effect of the maximum viscosity in aqueous alcohol?

A. It has a very marked effect on the question of foaming. It is usually stated that aqueous alcohol solu-

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tions foam, but that is not correct, except within a certain limit of concentrations. Since the alcohol reduces the surface tension at all concentrations, it will always form an alcohol rich film in all aqueous alcohol solutions; on the other hand with concentrations with probably from a trace of alcohol up to 47% alcohol, the alcohol rich film will be more viscous than the mass of the liquid, and consequently we shall have conditions of foaming so that if we beat up any aqueous solution from a trace of alcohol up to 47% alcohol or thereabouts—I don't guarantee the absolute accuracy of the figures—the mixture will foam. If, on the other hand, you take a point beyond the maximum viscosity, from 47% down to practically pure alcohol, those mixtures will not foam. Whereas, in the case of acetic acid, where there is no maximum viscosity, all solutions of acetic acid from the very dilute ones up to those which are nearly pure acetic acid, will foam.

Q.14. Can you show this by an experiment?

A. We have an experiment which will show that, and before I do that I would like to say one thing, that in all the experiments that I shall show, I shall of course give the weights which are used in each case, but the absolute values are of no importance whatsoever, because you will get exactly the same phenomenon over quite a range of concentration; for instance, in this experiment with alcohol, we are going to use 95% alcohol, because that is the form in which we buy it; but we would get exactly the same thing if we started with 99.5% alcohol and ran down to 50% alcohol; you

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can vary that proportion say 49% without affecting in any way the character of the result.

In some of the other experiments the range will not be so large, but the absolute values are of no importance whatsoever.

(Test No. 13.)

We have here a square glass jar, into which is poured about a quart of so-called absolute alcohol, which means as a matter of fact approximately 95% alcohol; it contains somewhere in the neighborhood of 95% alcohol and 5% water. We shall then beat that up with—beat that up in this square glass jar and, if luck is with us, you will see that it does not foam much. The time of the beating is quite immaterial, so, in order to save time we will only beat it for thirty seconds, but if anybody wants it beaten longer we will beat it as long as anybody wants it done. We will have to wait a moment until the machine is started upstairs so we will have a current. While we are waiting I will also add that unless otherwise stated the rate of the stirring is always about 1,700 revolutions per minute. Now, I do not guarantee the absolute accuracy of that.

Q. 15. MR. SHERIDAN: Professor, do you know what the diameter of the plates are?

A. I have those here. The rectangular glass jar is approximately four inches by four inches by twelve inches high. We are using a four-bladed propeller, with blades approximately an inch and a half to the centers, and half an inch wide. The diameter of the propellor shaft is approximately half an inch, and the machine is

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driven by a quarter horse power motor. The machine being started, the belt slips off, but you will notice that it is not frothing. That is not important, because the thing had not got up speed. (Machine started.) You notice it is being started up vigorously. I push the switch and there is not anything that even could be called a temporary froth. The bubbles arise, and disappear at once.

(Test No. 14.)

We will now repeat this experiment, starting with 1500 c. of tap water and add about 10 c.c. of the same alcohol, and stir it up about the same length of time.

Q. 16. BY THE COURT: This is to illustrate what?

A. This is to illustrate that in cases where we have a lowering of the surface tension, we may have either foaming or not foaming, depending on whether the surface film formed is more viscous or less viscous than the mass of the solution; in other words what I am trying to prove is that the important thing is to form a more viscous film at the surface. In the case of the alcohol beyond the concentration of 47% alcohol, the surface layer is less viscous than the mass of the liquid, and consequently the liquid does not foam. For concentrations of alcohol up to about 47%, the surface layer is more viscous than the mass of the liquid and consequently the thing does foam. Of course that does not give a permanent foam. We will pour out about 10 c.c. alcohol—as a matter of fact it is ten and a half —and we will add that to 1500 c.c. of tap water, and

we will stir this as before, about 30 seconds, unless somebody wants it stirred longer. (Starting machine.) You can see the difference in the look of things already. (Stopping machine.) And you see the condition—you see the difference in the behavior—you can see an inch or so of froth there, which of course is not permanent, but quickly dies down, but it is strikingly different from the other.

As far as I know, this experiment with a high concentration of alcohol has never been shown before to any audience. It was devised by my colleague, Prof. Briggs. If there is no further question we might leave this and go on.

Q. 17. Will you state whether salt solutions ever froth, and why?

A. A number of salt solutions will froth; for instance a 5% potassium chloride solution will froth, and Mr. Dosenbach showed in court the other day that a concentrated sodium chloride solution will also froth. This is interesting, because these salts all raise the surface tension of the solution, and therefore concentrate in the mass of the solution, leaving a water rich film or a salt poor film at the surface, and consequently one would normally expect these not to froth. As a matter of fact, however, potassium chloride, to take that instance, lowers the viscosity of the water, and consequently the water rich film is more viscous than the salt rich mass of the liquid and consequently we have a case precisely analogous to this one of the dilute alcohol solution, so that the behaviour of potassium

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chloride solution is accounted for in exactly the same way as we accounted for the behaviour of the alcohol poor solution.

Q. 18. Will you state why these froths that you have been discussing and have shown in the experiment are evanescent and die out?

A. The surface film is more viscous than the mass of the liquid, but the absolute viscosity is very low, and consequently these froths are evanescent, and as I showed in the case of the dilute alcohol solution, there is a very vigorous frothing, but it does not last at all.

Q. 19. What happens in the case of colloidal solution?

A. If we have a colloidal solution, such as soap or saponin, for instance, the surface film is very much more viscous than in the other cases, and consequently the froth is relatively stable. I imagine that everybody has seen soap bubbles. The foaming of beer is due to the colloidal proteins, and anybody who has ever poured beer into a glass knows that you get a foam which can be blown off. In the case of champagne I don't know whether there are any colloidal proteins, but certainly the content is low, and one gets under those conditions a bubbling which gives rise to a very evanescent foam.

Q. 20. What happens when one adds oil to water?

A. If we add enough oil we get a second liquid layer, just as in these cases which we saw yesterday; we have a layer of kerosene as a second liquid layer on top of the water. If the oil is more dense than the

water we would get the second liquid layer with the oil at the bottom and the water at the top.

Q. 21. What classes of oils do you distinguish?

A. Why, I think it is profitable to distinguish between oils which are practically insoluble in water and oils which are more or less soluble in water. Of course there is no sharp dividing line, but that does not prevent a classification being useful. For instance, it certainly is a good policy in every-day life to distinguish between animals and vegetables, and yet there are organisms which it is very difficult indeed to place under that classification, because the two do merge gradually one into the other, although, for every-day life, most of us can tell the wild flowers from the birds.

Q. 22. How is it that a practically insoluble oil forms a foam?

A. When you add a practically insoluble oil to water it is usually adsorbed by the water and spreads out as a thin film. That thin film gives you largely increased viscosity as was shown the other day, and since this is a surface film which has more viscosity than the mass of the liquid, you will get foaming, as has been shown in the case of the dilute alcohol solutions and the 5% potassium chloride solution.

Q. 23. What would be the effect of adding too much oil?

A. If you add too much oil—that is if you add a small amount of oil it spreads out and gives you a very thin film over the surface of the water; if you add a little more oil—oleic acid, for instance, it draws away

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from the oiled film of the water and gives you a globule or drop of oleic acid standing up there; depending on how you do it; you may get one drop or you may get several drops.

Q. 24. What are non-frothing oils?

A. The very insoluble oils are often called non-frothing oils, but I think it would be better, perhaps, to put it around the other way, that non-frothing oils are always insoluble oils; kerosene, for instance.

Q. 25. Is a practically insoluble oil necessarily a non-frothing oil?

A. No, I think not, because you might have a case where the oil adsorbed air very markedly, in which case it probably would give a good froth in spite of the fact that it was a practically insoluble oil.

Q. 26. What happens with moderately ~~in~~soluble oils?

A. With moderately soluble oils you get two effects; assuming that you add enough so that you get your second liquid layer—you get first the effect due to the second liquid layer, which is the same in nature as the effect of insoluble oil; you will also get a much greater effect—at least I think it is much greater—due to the dissolved portion of the oil, which will give you much more froth.

Q. 27. What are frothing oils?

A. Frothing oils as usually defined are oils which are either partly soluble in water or which contain a soluble or partly soluble constituent, and which show more or less selective a~~b~~dsorption for minerals.

Q. 28. What is the relation between a frothing oil and a non-frothing oil?

A. They pass continuously one into the other; you might have different oils—hypothetical ones—which are soluble say, 10% in water, 1% in water, 1/10 of 1% in water, 1/100 of 1% in water, and 1/1000 of 1% in water. Certainly the one that was soluble only to the extent of 1/1000 of 1% in water would be classed as an insoluble oil. Equally certainly the one that was soluble 10% in water would be classed as a frothing oil. Where you would draw the line in the other cases is perhaps a matter of personal preference.

Q. 29. Would you name a few instances of what would be classified as frothing oils?

A. Pine oil and eucalyptus oil can be taken as two instances of frothing oils.

Q. 30. What is the relation between a frothing oil and soluble frothing agents?

A. They pass continuously one into the other. If the frothing oil increases sufficiently in solubility, or if you take so little of the frothing oil that it is completely dissolved, it then becomes identical practically with the soluble frothing agents.

Q. 31. What are soluble frothing agents?

A. Soluble frothing agents are substances which give rise to a more viscous film; that is to say, in order to be a frothing agent they have to do that. They may be substances like alcohol and acetic acid

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that are miscible in water in all proportions under the conditions of the experiment. They may be substances like amyl acetate, phenol, aromatic hydroxy compounds, which are only partially miscible in water, or they may be substances like salt, which has a definite solubility in water, and then precipitates in a solid form.

Q. 32. Is saponin a soluble frothing agent?

A. Saponin might be called a soluble frothing agent, except for the fact that it plays havoc with flotation and consequently is usually excluded from it. I noticed that yesterday Mr. Williams elected to call these things mineral frothing agents, meaning thereby that these frothing agents showed a greater or lesser selective absorption for mineral with respect to gangue. There is absolutely no objection to that definition as long as one understands what it means; on the other hand, it is a little better, I think, to say soluble frothing agents, and to note that we are not counting in saponin and things of that type.

Q. 33. Is there any sharp dividing line between non-frothing oils and frothing oils? and soluble frothing agents?

P. 3147, L. 26, cancel "oils" and insert "practically insoluble oils and range" after "with"; cancel "and change"

continuously into a so called

On the other hand it is a very useful classification for the purposes of discussion.

Q. 34. How would you classify phenol?

A. Phenol is a good illustration, because it has been classified in two different ways. Dr. Adolf Liebmann said that when you add a small amount of phenol so that it is all dissolved in the water, it is a soluble frothing agent; but if you add an excess of phenol, it is an oil, and therefore, of course, would come under the head of partially soluble oils. That is perfectly legitimate as far as I can see, provided you choose to define things this way, and shows that there is no arbitrary dividing line between a soluble frothing agent and a partially soluble oil; because in this particular case it has been classified, at any rate, as one or the other, depending on the relative amounts of phenol to water.

Q. 35. Are these general relations true of other liquids than water?

A. The whole discussion has really been general; I have used the word "water" because it is more convenient than to talk about liquid A and liquid B; but the relations are true of any liquid where you have formed a more viscous surface film; as a matter of fact the crude vegetable oils, to take a single instance, do froth when shaken. I have never tried that in the square jar machine, but I imagine it would be a gorgeous experiment.

Q. 36. Do they froth more readily than the refined oils?

A. The crude vegetable oils froth distinctly more than the refined oils, because they contain more colloidal

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material, which has been removed to a greater or lesser extent by refining; and as a matter of fact Baskerville points out that this frothing may be used as a qualitative test to show something in regard to the degree of refining.

Q. 37. Is the frothing of the oil important in the flotation process?

A. I think not. As far as I know, it is not; it does not come in anywhere, because under ordinary conditions the amount of oil used is relatively small in comparison to the amount of water.

Q. 38. What kind of bubbles does one get in the case of froths with oils or soluble frothing agents?

A. You get under all conditions a froth which is either an oil layer or an oil rich solution next to the air. In making that statement I am using the word oil in its broadest sense, to include soluble frothing agents.

Q. 39. How can a froth be made more stable?

A. Since the instability of the froth is due to the low viscosity of the cell walls, it can be made more stable by adding something or other which will increase the viscosity of the cell walls, or of the films constituting the cell walls.

Q. 40. What would be the effect of adding a viscous non-frothing oil?

A. If one adds a viscous non-frothing oil in suitable amounts, one may easily stabilize the froth. As a matter of fact that can be done with the so-called oil mixture of the Butte & Superior Company.

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That oil consists of 70% fuel oil, which is a viscous oil, 12% kerosene and 18% pine oil, which is a frothing oil. I made one experiment in which 4.5 gms. of this oil was added to 1500 c.c. tap water at about 25°. There was also added one cubic centimeter concentrated sulphuric acid. The resulting mixture was stirred for thirty to ninety seconds, in different experiments, at about 1700 revolutions per minute in the square jar machine that you see there. And a fairly permanent froth was obtained about three-quarters of an inch thick.

Q. 41. Can you stabilize a froth in any other way?

A. A much more amusing way of stabilizing a froth is by adding a solid to it.

Q. 42. What solids will stabilize the froth?

A. Any solid which is adsorbed by the oil layer, by the oil-water interface, or by the oil-rich film, will stabilize a froth more or less completely.

Q. 43. What is the effect of lycopodium powder with

P. 3150, L. 22, insert " first that water and pine oil when stirred give no permanent froth. There is a temporary froth but no permanent one. We showed " after " showed "

and lycopodium powder give no permanent froth and that the lycopodium powder becomes distributed throughout the mass of the water coloring it yellow. If, however, you take 1500 c.c. tap water, 1 c.c. pine oil, and 8.3 gms. lycopodium, put in the square jar machine and stir for about thirty seconds you get a solid, yellow,

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very dry, permanent froth about 1.5 inches thick. The water is slightly cloudy, but not much so. In other words, pretty nearly all the lycopodium powder has gone up into the froth.

Q. 44. Will you show us that experiment?

A. In order that you may see that you get no permanent froth with the lycopodium powder we will put the lycopodium powder into the water and beat that for thirty seconds first. I take it that all of you know that pine oil does not give any permanent froth with water. (Test No. 15.) You see that there is no permanent froth and that the mass of the liquid is cloudy and colored yellow. Now, we will add about 1 c.c. of pine oil and stir again. (Test No. 16.) You see that we get a relatively thick froth and that the mass of the liquid is no longer colored yellow and is only faintly cloudy. Practically all the lycopodium powder has gone up into the froth. I may state also that this experiment has never been shown before to an audience, so far as I know.

Q. 45. What is lycopodium powder?

A. Lycopodium powder is the spore of something or other, of either a moss or a fern, I don't know which. I think it is a fern.

Q. 46. Vegetable matter?

A. Oh, yes, it is vegetable matter, organic matter. It is a seed. I so understand.

Q. 47. What is the effect of white lead?

A. We tried an experiment with white lead, which is

basic lead carbonate and when water and white lead are stirred together there is no permanent foam. The white lead is distributed all through the mass of the liquid, and makes it a very opaque white. When, however we take 1500 c.c. tap water at about 25°, 48 gms. of white lead and 1 c.c. of pine oil and stir the mixture for half a minute or more we get a stiff froth. It makes no difference whether the pine oil be added to the water before the white lead or afterwards. That is, the order of mixing is immaterial. A great deal of the white lead is not carried up by the oil and the water consequently remains opaque and milky. In the case of the lycopodium powder practically all of the lycopodium powder was carried up by the oil. That was not the case with the white lead experiment.

Q. 48. Can't you perform the white lead experiment?

A. I think so. I hope so. (Experiment No. 17.) You see that there is no permanent froth and the white lead is dispersed apparently uniformly through the mass of the liquid. We will add 1 c.c. approximately of pine oil. (Experiment 18.) That ran about thirty-five seconds. You see that we get a very pretty, thick froth, and that the solution now is not entirely clear. I may say also that so far as I know this is the first time that this experiment has been shown to any audience. I should like also to add one statement in regard to the previous experiment with lycopodium powder. Mr. Williams has just told me that Mr. Higgins has done that experiment before. As Mr. Higgins had not told

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me about that, of course I made the statement that I did not know that it had ever been done before. If I had known that Mr. Higgins had done it I would not have bothered to carry the thing through myself.

Q. 49. Will white lead stabilize the alcohol foam?

A. In experiments that we have made we get no stabilization. When you stir a dilute solution of alcohol and water as was shown in the second experiment you get a frothing which is not permanent. When you add white lead and stir, the frothing is also not permanent, although it looks as though the alcohol froth did not break down quite so rapidly. To make sure of that one would have to follow it carefully with a stop watch which I have not done because I don't care anything about it. The trouble seems to be that the white lead is not adsorbed by the alcohol and consequently does not get into the film. Of course if it doesn't get into the film it can't act as a stabilizer, by definition.

Q. 50. And what is the effect of alcohol and kerosene with white lead?

A. We ran the whole set. Alcohol and white lead and water give no permanent froth because the white lead does not go into the alcohol film. Kerosene, white lead and water give no permanent froth apparently because kerosene is a non-frothing oil. In order to be sure that there was no mistake anywhere we tried a mixture of alcohol, kerosene and water. That gives no permanent froth. In other words we have tried our three combinations. Then we tried a mixture of alco-

hol, kerosene, water and white lead. We took 1500 c.c. of water and 4 c.c. of kerosene, 10 c.c. of 95% alcohol, and 20 gms. of white lead. These were stirred for a minute or two and a good stiff froth was obtained. The water was still milky because the white lead does not go up completely into the films.

Q. 51. Can you show us that experiment?

A. Yes, sir. (Experiment #19.) We have shown you that alcohol and water give a froth which is not permanent. We do not need to show you that kerosene and water do not, because kerosene, by definition, by general acceptance is a non-frothing oil. We will now show you that a mixture of kerosene, alcohol and water as stated does not give a permanent froth. You get an evanescent froth. It is practically all gone except a few stray bubbles already.

THE WITNESS: We will now add white lead, (Test No. 20) 20 grams of white lead, and we will stir this froth approximately a minute. (Stopping machine.) It is not a very striking experiment; something or other went wrong.

Q. 52. BY MR. WILLIAMS: Tell what you got for the sake of the record.

A. For the sake of the record I will state that there is a very thin line of a froth scum at the top; nothing like what I hoped or expected or thought it should have done. We will start the motor again and see what happens. (Running motor again.) Well, the laugh is on me temporarily. If it is permitted, we will show that

experiment again when it will work. Something has gone wrong, I don't know what, but it seems to be another instance where the experiment has failed but the principle remains the same.

Q. 53. THE COURT' It is not a question of doing it here, is it?

A. Oh, no; it is simply a case that when I did the experiment before it worked, but in many of these things a very slight change makes a difference. It may be it would have worked better if we had put all the things in at once and had stirred them. In the case of the previous experiment with the pine oil and the white lead, I made actual determinations, that the order of adding made no difference; I don't remember whether I did in this particular case, and that may be the difficulty and it may not.

Q. 54. What are you trying to illustrate?

A. I was merely showing another instance of the fact that one can stabilize by means of a solid, and that this is rather an interesting case, because we had here a so-called non-frothing oil, kerosene, and a so-called frothing agent, alcohol, and that under those conditions we were to duplicate the ordinary practice of a froth stabilized by mineral, using a substance which does not occur in nature as a mineral; merely to show that the general principle was the same, that any solid which comes up under the circumstances into the film will stabilize it. The question of the success or failure of the

experiment is absolutely immaterial, except that one likes to have them go.

MR. SCOTT:

Q. 55. How does lycopodium powder behave with kerosene and alcohol?

A. Lycopodium powder with kerosene and alcohol gives, or gave, a good stable froth. I have tried 1500 c.c. of tap water, 10 c.c. of alcohol, 2 c.c. of kerosene and about 3 grams of lycopodium powder. After stirring from 30 to 90 seconds a good froth was obtained, which was approximately 3/8 of an inch thick, and the water was somewhat cloudy.

Q. 56. Will you show us that experiment, Professor?

A. No, I think not, thank you.

Q. 57. Can you stabilize alcohol froth with lycopodium; were you speaking of lycopodium and alcohol?

A. I am not ready to show that; it is not the one that I want to show. After that we went back and tried to see if we could stabilize alcohol froth with lycopodium powder, and it worked fairly well; that is, we took 1500 c.c. of tap water, 20 c.c. of alcohol and anywhere from 8 to 12 grams of lycopodium; they were stirred for about a minute, and we obtained a pasty froth about half an inch thick. The interesting thing about this experiment—when it works—has been—so far it worked every time, but I don't guarantee anything in future—has been that the whole of the lycopodium powder goes up into the froth, and the water be-

low is absolutely clear and colorless. It is not a tremendously successful experiment as regards the getting of a permanent froth, because the alcohol evaporates readily from the bubbles, and consequently the froth breaks down in the course of time. I shall be very happy to show you that experiment; that is the one that I think you asked for.

Whereupon an adjournment was had until 2:00 o'clock p. m. Friday, April 27th, 1917.

Friday, April 27th, 1917, 2:00 P. M.

BY MR. SCOTT:

Q. 58. Mr. Bancroft, do you wish to repeat the experiment illustrating the effect of white lead upon alcohol and kerosene in the water? I think it was given #20.

A. (Repeating test #20.) You see we have a thick. stable froth about an inch thick, and the water is still cloudy below it. The trouble with the previous experiment apparently was that we added too little white lead and too much of it stayed down in the water to enable us to stabilize the froth satisfactorily. We ran the thing after the close of court by simply adding more white lead to the thing that had failed and it worked. In this particular one, as a matter of fact, I have changed the proportions as given before so as to play safe, and I will read what this experiment actually was.

1500 c.c. tap water at 25°; 10 c.c. 95% alcohol; 6 c.c. kerosene; and 48 gms. white lead. It is a little more kerosene, half as much again and more than double as much white lead. While I was a student in Germany I used to go to the opera and the first performance that was given they advertised it in large letters as "First Performance." For the second time they advertised "First Performance Repeated." And, consequently then, this is the first time that this experiment has been shown to an audience with failure and also the first time it has been shown with success.

Q. 59. You stated just before recess, Professor Bancroft, that you could stabilize an alcohol froth with lycopodium. Will you show us that experiment?

A. Yes, I will show that also.

Q. 60. Before you do that I would like to ask you a question about this one you just performed and that is why this mixture stabilizes, having the white lead in it, when kerosene nor alcohol alone will form a stable froth?

A. Well, kerosene is a non-frothing oil, so-called, which means simply that it does not froth readily. It, however, does hold or carry the white lead, the alcohol will froth, but apparently has no carrying power for white lead. By mixing the two, we get the good properties of both. The reason for putting on this experiment was merely to show that we are getting with a mixture, and in technical practice I understand that they do use mixtures a great deal, we are getting a stabiliza-

tion without using any of the regular minerals. There is one thing that it perhaps might be worth while to say about the kerosene, and that is that kerosene would be classed essentially as a non-frothing oil. That does not mean that it does not froth at all, but that the froth is very instable and breaks down very readily, but of course if you had a substance there which was adsorbed very much by the kerosene, as you may have with several minerals, then under this condition you could build up a froth. I do not mean to say that in any way you could not build a permanent froth with kerosene if you had a suitable solid, because as a matter fact people have done it.

The other question was the one about the alcohol and the lycopodium?

Q. 61. Experiment showing the stabilization of an alcohol froth with lycopodium.

THE COURT: I suppose we can assume that all of these experiments are to serve some useful purpose?

MR. SCOTT: The experiments are to show the real facts of the frothing, that is to what the stabilization of a froth is due, and I think Professor Bancroft will sum up after a few answers the exact conclusions for which these experiments are the foundation.

A. In the experiment in the stabiliaztion of alcohol froth by lycopodium powder we use 1500 c.c. tap water at about 25°; 10 c.c. 95% alcohol, and about 12½ gms. of lycopodium. And if it works well we ought to get a pasty froth and as I said the solution, the liquid below,

should be almost absolutely clear. We have 1500 c.c. of water now in there and we will add the lycopodium powder and the alcohol.

(Test No. 21)

THE WITNESS: You can see that that one works as per schedule.

Q. 62. Can you stabilize an acetic acid froth?

A. Yes, acetic acid has been stabilized by mineral at one time by Mr. Dosenbach, and we can stabilize it, using an entirely different substance than has been used before, by putting in lamp black.

Q. 63. Have you an experiment to illustrate that?

A. Yes, we have an experiment to illustrate that.

Q. 64. We will have you perform that one, then.

(Test No. 22)

A. A preliminary run was made with water and lamp black, to be sure that we did not get froth with lamp black alone, so we took 1500 c.c. of tap water and 1 gram of lamp black and stirred them in the machine and we got no froth. The lamp black seems to be distributed uniformly throughout the liquid, except that there are a few patches of thin skin on the surface of the liquid. I imagine that the lamp black is not absolutely pure, as lamp black never is; but so long as one does not get a froth with it, it makes no difference in the principle of the experiment. Then I added acetic acid, 10 c.c. of 99% acetic acid—

(Test No. 23)

99% acetic acid is the form in which it is bought

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from the druggist—and you get a stable, coarse froth, and the acetic acid does not take up all the lamp black, and consequently the body of the liquid remains black.

We have now the water and the lamp black alone. (Running motor.) You see you get a few bubbles which die down at once, and you see the whole mass of the liquid is black. Of course one might have known that it would be, because India ink is made of suitably prepared lamp black, and that dissolves in water. Now we will add 10 c.c. of 99% acetic acid and stir again. (Running motor.) It has been stirred for 60 seconds. We get, under those circumstances, a very small amount of froth; we ought to have got more, but we didn't. We will stir it again. (Running motor.) It looks again as though ~~like~~ there probably were not quite enough lamp black in it. Not quite enough lamp black and it does not work well, would seem to be the record for that experiment.

Q. 65. MR. WILLIAMS: Won't you state for the record what you see there.

A. Oh, certainly. The result of the experiment is not a success. There are only a few bubbles which are distinctly not permanent. We are running in rather hard luck.

Q. 66. MR. SCOTT: Would more lamp black make it better?

A. Unquestionably.

Q. 67. Would it be worth while to repeat it?

A. If it were for the sake of the experiment I would

put in more lamp black and run it; but that is for you to say. If we put in more lamp black it will stabilize it, that is certain.

Q. 68. Suppose you do that and see the effect of adding more. How much did you put in before?

A. Well, another gram ought to do it without any trouble; it looks as though it ought to have done it there.

(Test No. 24, adding more lamp black.)

Now, adding one more gram of lamp black, making a total of two grams, and you get a fairly deep froth made of relatively large, coarse bubbles.

Q. 69. The froth is about how deep would you say, two inches, or three?

A. It is an inch and a half, I should judge, on an estimate. If anybody has a rule we can tell more closely.

MR. WILLIAMS: I have a rule.

A. I will let you measure it; any measurement you take is satisfactory.

MR. WILLIAMS: Something a little less than two inches.

A. That is more than I should have given it myself.

Q. 70. BY MR. WILLIAMS: In speaking of it as a coarse froth, as I look at it the bubbles seem to be an inch or so across, many of them.

A. At the top, the upper bubbles are very large, and the lower bubbles are smaller.

Q. 71. MR. SCOTT: What effect does lycopodium have on an acetic acid froth?

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A. Lycopodium does not stabilize it, whereas lycopodium will stabilize two of the others that we have tried. It has no effect or practically no effect on acetic acid, showing that it is a question of selective adsorption, and not of any one substance being necessary to stabilize it.

Q. 72. Can you show that easily?

A. Yes, I can show that.

(Test No. 25)

A. In this experiment we put in 1500 c.c. of tap water at about 25°, 10 c.c. of 95% acetic acid, and about 8 grams of lycopodium powder, and stir for 60 seconds.

A. The foam dies down fairly rapidly, the last part of course going more slowly and leaves just a mere line of lycopodium powder along the top, and nothing in the way of a deep or stable froth.

Q. 73. What effect does white lead have on phenol froth?

A. We tried phenol with white lead. I can give you the actual figures. When we took 1500 c.c. of tap water, 2½ grms. of phenol, 10 grms. of white lead, there was no sign of any stabilization and consequently we did not go on and add more white lead because the bubbles showed absolutely no signs of being coated and it seemed perfectly hopeless.

Q. 74. Can you stabilize the phenol froth without using mineral?

A. Yes, you can do it by adding lamp black. In the experiment as I carried it out at first we took 1500 c.c.

of tap water at about 25° and 2½ gms. of solid phenol and added 1 gm. of lamp black and stirred and it gave us a very coarse froth. In view of the way in which the lamp black acted the last time I have had another gramme weighed out and so we add at first one and will add another one if necessary. (Experiment #26.) About 60 seconds. We get a small amount, a quarter of an inch perhaps of a coarse black froth. I can get more by adding another gram of lamp black if desired, but it merely takes up time, hardly worth while.

Q. 75. You might, as you have the mixture here, add another gram?

A. (Repeating experiment #26 with the addition of one gram of lamp black.) About sixty seconds. That gives 1½ to 2 inches of a coarse black foam.

Q. 76. Now, do these experiments show the general theory of frothing to hold good?

A. I think they do. I think they show that the general theory as outlined holds in every detail and enables us to predict what will happen in case of the addition of these stabilizing agents, and that this theory holds for any liquid or any combination of liquid.

Q. 77. What is the state of things in the cell wall of these froths?

A. The cell walls therefore have a layer of oil or oil-rich solution next to the air in all cases, and the cell walls are stabilized by the presence of the adsorbed solid material.

Q. 78. Is there any relation between oil and the total solids in these experiments?

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A. In some of them there was absolutely none because in the experiments where there are no solids in at all of course you cannot speak about the relation of oil or soluble frothing agents to total solids, because it is meaningless. It could be figured out as a million, ten million or one thousand million per cent, just exactly as one would wish to do it.

Q. 79. Is the nature of the froth always the same when no solids are present?

A. The nature of the froth is always the same when no solids are present and consequently of course there cannot be any critical point under these circumstances and so far as I know nobody has ever claimed the existence of a critical point when one had oil and water alone. I use "oil" of course in the broad sense.

Q. 80. What is the efect of a solid?

A. The effect of a solid is to stabilize the froth by making the cell walls more viscous.

Q. 81. And that was the effect of the solids you used in this experiment?

A. Yes, that is the effect of the solids used in this experiment, and as a matter of fact we have used in there lycopodium powder, white lead, lamp black, and of course everybody else has done it with mineral, showing that the nature of the solid is absolutely immaterial except in so far as it determines whether it goes into the film or not. But once you get a solid into the film then it increases the viscosity and makes the thing stable.

Q. 82. Was the effect of these different solids known before?

A. I had supposed that it was not. I did not know until today that anybody had ever tried lycopodium powder as a stabilizing agent for froth. I know of no record of it in the literature and I did not know of anybody except this case of Mr. Higgins which he did not report to me, naturally—of anybody stabilizing a froth with lycopodium powder or with white lead. The lamp black I imagine has been used.

Q. 83. Do you consider that these experiments prove the correctness of the theory?

A. Why, it is usually accepted as a very satisfactory test of the theory that it enables you to predict results which have not been obtained before. That does not mean that you might not predict results which you cannot perform by means of a theory that is not right, but you can't keep it up long without getting caught.

Q. 84. What is your conclusion in regard to the type of froths?

A. That since the action of the solid is simply to stabilize the film by increasing its viscosity, there is therefore no change in the type of froth due to the addition of solid and consequently we have the same type of frothing process that we have when we have oil and water alone; in other words, a froth with an oil layer or an oil-rich solution next to the air. Always, as I said, using "oil" in the broad sense to include the soluble frothing agents.

Q. 85. Are these froths of the same type regardless of the ratio of oil to stabilizing solid?

A. They are absolutely.

Q. 86. What ratio of oil to the stabilizing solids have you obtained in these experiments that you have performed?

A. Taking these data that I have one can calculate out a number of results. That is, where a stabilizing solid was used without any gangue, good results were obtained with 1 c.c. of pine oil, specific gravity about .93 and 8.3 gms. of lycopodium powder. That is the experiment that was shown. That is a percentage of oil to solid of about 11%, in round numbers. Then, in the case of the white lead and the pine oil we had 4 c.c. of pine oil and 48 gms. of white lead, a percentage of oil to solid of nearly 8% in round numbers. Then in the experiment with the alcohol, kerosene and white lead, the one that worked, we had 10 c.c. 95% alcohol, 6 c.c. kerosene and 48 gms. white lead, a percentage of kerosene and alcohol to white lead of over 25% in round numbers. In the case of acetic acid and lamp black we had 10 c.c. of 99% acetic acid and 1 gm. of lamp black. That would be a percentage of acetic acid to lamp black of one thousand, in case you take the acetic acid as having the same specific gravity as water. As a matter of fact I think it is slightly denser, which would run the ratio of oil, meaning acetic acid, to total solid up to something over one thousand per cent; but I don't see any advantage in calculating that any more closely.

Q. 87. What conclusion do you draw from these ex-

periments in regard to the froths made in the presence of mineral?

A. Why, that since the froth is stabilized by the mineral in exactly the same way that it is by the lycopodium or the white lead or the lamp black, that the froths which one gets when working with ore are exactly the same type as the froths that we have made here with white lead and lycopodium and lamp black, and we could have gone on and increased that number indefinitely, if there had been any need of it—consequently I cannot see how there can possibly be any critical point at a ratio of .5% oil to ore or thereabouts; I cannot see that we have any possibility of a so-called critical point in there anywhere.

Q. 88. Can you illustrate that by experiment, the absence of any critical point?

A. Yes; we have three experiments which I will now show, and which are the last three, where we will take different amounts of oil to ore. The froths made with anywhere from one-tenth of one per cent, of oil upwards —. They look exactly like, they behave exactly alike in mill practice and they are theoretically exactly alike. We will show three, one carrying in round numbers .3% of oil, one in round numbers 1%, and one somewhat higher, and I hope that they will all look very much alike; they certainly do when we ran them in advance.

(Test No. 27)

The conditions of the first experiment are, 1500 c.c. tap water at about 30°; one c.c. concentrated sulphuric

acid; 300 grams Butte & Superior ore, which I am told contains about 17% of mineral—I am taking the ore as it is given—and we add to that one c.c. of oil mixture. I have given the composition of the oil mixture in my testimony this morning, and I am told that the specific gravity of that is about .87, and for our purposes we might call it .9, or we might call it 1., without introducing any error of any account; that is, in this first case, as we have one c.c. of oil mixture to 300 grams of Butte & Superior ore, we have got something under one-third of one per cent of oil to ore, barring mistakes in weighing. We will stir each of these for three minutes at about 1700 revolutions per minute. This is one c.c. of the oil mixture.

Q. 89. MR. WILLIAMS: Did you figure the percentage of oil to ore?

A. It is something less than one-third of 1%. It would be one-third if we called the specific gravity of the oil one; it would be a little less than that if you call it .87. It would be just about .29 of 1% of oil to ore.

(Running motor.)

Just about three minutes.

MR. WILLIAMS: We will want a specimen of this froth for analysis. I suppose we can arrange to divide the froth as we have in cases before?

THE WITNESS: That is for Mr. Scott to decide. As far as I am concerned you are welcome to the whole of it.

MR. SCOTT: You can have samples of the ma-

terial, and if you wait till we are through you can have samples of the froth.

THE WITNESS: I think we had better have all three of them set up side by side.

Q. 90. MR. SCOTT: I thought you were going to make all three in this one jar.

A. Oh, dear, no; because then people might forget that they looked alike. This is .29% oil to ore.

(Test No. 28)

The next experiment will be exactly like this one, except that we will add 3 c.c. of oil mixture, instead of one cubic centimeter. That will give in round numbers a ratio of oil to ore of .87%, in case you take the specific gravity of the oil mixture as .87. To run it up or down a little will run the percentage up or down also. I have not determined the density of it, myself. This will also be run three minutes, exactly the same as the preceding one, the only difference in the experiment being in the difference of the ratio of oil to ore.

(Running motor.)

About three minutes.

(Test No. 29).

The third experiment of this series, and the last one to be shown today as far as I know, is the same as the other two, except that 5 c.c. of oil mixture are added instead of 1 c.c. in the first case and 3 c.c. in the second. If we take the specific gravity of the oil mixture at .87, that figures out in round numbers 1.45% of oil to ore (running motor). About three minutes. I think it will

take an expert to see any fundamental difference between those three froths.

MR. WILLIAMS: Now, Mr. Scott, may we have specimens of each of these froths, after court has adjourned?

MR. SCOTT: It will only take a few minutes, your honor, to supply these samples, and I think we may as well do it now.

MR. WILLIAMS: I would just like to call your attention also to the showering of the zinc in this last froth.

MR. SCOTT: You have been stirring it?

MR. WILLIAMS: No. The showering of the globules of zinc, that came down, as shown there at the very beginning. Your honor did not see that side of it. It is a little plainer there than anywhere else.

THE COURT: You mean that it has fallen down?

MR. WILLIAMS: That the zinc has fallen from the froth down and mixed with the gangue.

MR. SCOTT: There is the same thing there in each one of these others (referring to each of the three samples).

THE COURT: No objection to taking these samples now if you desire.

MR. DOSENBACH: I am afraid if I mix them up I can't tell which is which.

MR. SCOTT: I don't remember how they were put up.

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MR. WILLIAMS: That is perfectly clear. This is the last.

THE WITNESS: If your honor please, I should like to correct one statement which apparently was in error. I understood that this Butte & Superior ore had a mineral content of about 17%. I am told now that as a matter of fact this particular ore runs about 12.6 mineral. That makes absolutely—has absolutely no effect on the experiment because we are weighing out 300 gms. of ore and the ratio as given are of oil to ore.

MR. SHERIDAN: 12.6 zinc.

THE WITNESS: All right, we will get it straight somehow. I am now told that it is 12.6% zinc. It has no bearing one way or the other except I would like to have it straight.

Q. 91. MR. SCOTT: Is there any reason why a soluble frothing agent should not in itself produce separation?

A. There is no theoretical reason why a soluble frothing agent might not be used by itself to produce separation; and cases of that sort are known.

Q. 92. In which separation has been produced?

A. In which separation has been produced by the use of the frothing agent alone.

Q. 93. What is the objection to using soluble frothing agents alone?

As a general thing the adsorption of the frothing agent by the mineral is not very marked and conse-

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quently the flotation is not as satisfactory as one would like in most cases.

Q. 94. And how has the difficulty been got around?

A. The difficulty has been got around in a great many cases by adding a non-frothing oil, so-called, which is adsorbed very strongly by the mineral and which consequently has very marked flotation power.

Q. 95. What about carrying oils, so-called?

A. The non-frothing oils which are adsorbed very strongly by the mineral are usually termed "carrying oils" because they hold up the minerals. They do not in themselves make so much froth.

Q. 96. Which will be washed out of the mineral more readily, the carrying oil or the frothing oil.

A. Since the carrying oil is adsorbed more strongly by mineral than is the frothing oil, when you use a mixture, the frothing oil will necessarily be washed out of the mineral if you treat it with water more rapidly than will the carrying oil. If the frothing oil were adsorbed more strongly than the carrying oil there would be no point in adding the carrying oil.

Q. 97. Is this true experimentally?

A. I have no direct, personal knowledge on the subject, but I am told that that is the case. I have been told it personally and I have read it in various places; but I have never made any experiment on the point myself.

Q. 98. What would be the effect of treating a frothing oil with a large quantity of water?

A. That would depend a little on whether the frothing oil were a pure oil or whether it was an oil having soluble or somewhat soluble contents. If you wash a pure frothing oil with water repeatedly you dissolve a certain portion of it, anything up to one hundred per cent. As an illustration you might cut it to ninety per cent or eighty per cent or seventy per cent or sixty per cent, depending on how long you washed, but the oil that is left will of course be identical in kind with the original oil, although less in quantity, and will consequently have the same frothing power. If, on the other hand, you have an oil which contains soluble or partially soluble contents then if you wash you will wash out these contents and you will be left with the so-called insoluble content of the oil and you will have passed from a frothing oil to one which approximates more or less closely, depending on the degree of washing to a non-frothing oil.

Q. 99. What is the theoretical relation between the amount of oil and the amount of the ore?

A. If you had the ideal state of things where you got one hundred per cent recovery and one hundred per cent of concentrate it is quite evident, if everything else is kept the same, the quality of the froth and the quantity of the froth will depend solely on the ratio of oil to mineral. That is because under these circumstances the gangue is merely an inert substance at the bottom of your vessel.

Q. 100. What would be the effect of gangue?

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A. Of course in so far as any gangue is carried up into the mineral, that is going to change things. In so far as any mineral is carried down by the gangue, that is going to change things, and so far as the gangue carries down some oil, apart from the oil that goes down with the mineral, which may be the case, that will also change things so that the relation may easily be obscured, somewhat.

Q. 101. Is it necessary always to use the same per cent of oil to mineral?

A. No, that is not necessary at all because of the fact you can stabilize the froth with varying amounts of mineral. That is—of course you get froth of a slightly different character but over quite a wide range of oil to mineral, you will get a pretty nearly stable froth and consequently it is not necessary to keep the ratio of oil to the mineral absolutely constant; and I imagine that is one reason why people have overlooked the fundamental importance of the ratio of oil to mineral. It is a very natural thing to do.

Q. 102. Within your information is there anything in mill practice, any evidences in mill practice that the ratio of oil to mineral is an important thing?

A. I have no personal knowledge of the mill practice, but in Mr. Wickes' testimony the other day it appeared that it was the practice to increase the amount of oil somewhat when the tenor of the headings run out. And other people have told me that that is a general practice. It looks a little as though the mill practice were distinctly in advance of the patents in suit.

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Q. 103. Have you made any experiments yourself on that point?

A. Nothing very accurately. I made one rather crude experiment merely to satisfy myself how much variation there was likely to be. To fifteen hundred cubic centimeters of tap water at 50°—there or thereabouts—there were added 300 gms. tailings which I am told contained about one per cent mineral, which would make, in other words, about 3 gms. of mineral in 300 gms. of tailings. There were also added 1 c.c. sulphuric acid and 1 c.c. pine oil. In the second experiment the mixture contained 1500 c.c. tap water, 5 gms. of what I was told was 65% concentrate containing roughly about 3.3 gms. mineral, very nearly the same as in the other case, 10% difference if you take the tailings as being absolutely 65, which I assume is not important. one cubic centimeter sulphuric acid and 1 c.c. of pine oil. Under these conditions you have the same amount of water, the same amount of acid, the same amount of pine oil and approximately, within the limits of the analyses given me, the same amount of mineral; but in one case you have got a great deal more gangue than in the other. And now when these were stirred, it did not come out quite the way I hoped it would—there was distinctly more mineral in the froth, judged by the eye, in the second case where I was using the concentrate than in the first because of the larger amount of gangue. carrying down some mineral, so that it is only an approximate experiment and a crude comparison, but it is

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really surprising to see how nearly alike the two froths were when we consider that the percentage of oil to ore was about .62 in the one case—I think that is probably figured on a specific gravity of .9—it is of no importance anyway—and about 18.6 in the other. That is the ratio of oil to ore was something like thirty times as great in the one case as in the other, but the ratio of oil to mineral was practically the same. And, while the froths were not identical, they were very similar indeed.

Q. 104. You used the word mineral, meaning metalliferous mineral all along?

A. Meaning metalliferous sulphide; I assume that that was the correct technical term. I would be very glad to change it if it is not.

Q. 105. What would be the variations in the dilution of the pulp?

A. If you have a soluble frothing oil present in the oil mixture that you are using, having more water in the pulp will of course give you a more dilute solution, and will consequently affect the frothing power; it would be more or less euqivalent to using less of your frothing oil; consequently one would expect to find that in any given case, if you keep everything else constant and increase the amount of water in the pulp, you would have to add more oil.

Q. 106. Have you any information as to mill practice that would serve to confirm that conclusion?

A. That part was brought out in Mr. Wickes' testimony, that when the amount of oil in the pulp was in-

creased—I prefer not to say diluted, because there seems to be some difference of opinion about that; some people say that the dilution increases when you have more water and some people say that the dilution increases when you have less water—so I prefer to say that in Mr. Wicks' testimony it seemed to appear from his data that more oil was needed when the pulp contained more water. I have been told since then that that is the opinion among many of the mill men. I have no personal knowledge of it, beyond hearsay evidence of this sort.

Q. 107. Under what conditions would these relations occur, strictly?

A. These relations, as I said, would hold strictly for the case of 100% recovery of a 100% concentrate.

Q. 108. But such a state of things is not realized, is it?

A. As far as I know, such a state of things is not realized either in mill practice or in the laboratory.

Q. 109. What are the disturbing conditions?

A. There are a good many things that make trouble there. If the froth is too stiff, of course there will be a tendency of the gangue to become entrapped in it. If the gangue is very finely divided, it will settle more slowly, and consequently the tendency of it to be entrapped will be greater. On the other hand there will also, of course, be a tendency for the mineral to be carried down by the gangue, either because it is entrapped or it may be because when bubbles coated with mineral come in

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contact with gangue during the agitation, some of the mineral will be rubbed off mechanically, and consequently will be in the same state as it would have been if it had never been attached to a bubble. And further, of course, the stiffer the pulp, that is, the less water in the pulp, the greater the danger of the mineral being carried down. Of course the actual effect of those things will vary in each particular case, with the nature of the ore, the nature of the gangue, the nature of the oil used, the temperature, the question of what you add in the way of sulphuric acid or copper sulphate, and with the nature of the stirring; so that it is probably a very complicated problem. But by keeping everything as nearly constant as possible, temperature, sulphuric acid, nature of ore and nature of oil and degree and manner of aeration, so that your only variables—your things that change—are the concentration of the pulp and the amount of oil and therefore the change in quantity—then I think that there would be no difficulty in verifying all these conclusions from mill practice.

Q. 110. Will the use of moderate amounts of oil give better results than the use of a minimum amount?

A. Why, it seems to me that it should, because, if you did not have too stiff a froth, you will get more chances for the gangue to settle, and of course also if you get your oil bubbles overloaded with mineral, again there will be danger, so that I would imagine that you would not get the best results in case one worked down to the minimum possible amounts of oil. As I said, I have no personal knowledge of that, but I suppose—I haven't

the slightest doubt but that mill practice will confirm that statement.

Q. 111. What will happen if a single particle consists both of mineral and gangue?

A. Of course if you have a single particle that has mineral on one side and gangue on the other, no amount of flotation will separate those two; it will either go up into the froth or down into the gangue, depending on the relative amounts of mineral and gangue in the particle; and the only remedy I see for that is more efficient grinding.

Q. 112. Up to this point you have a theory which covers the whole ground to your satisfaction?

A. It seems to me that the theory which I have stated enables us not only to describe all the facts that are known, but to predict a number of facts which were not known before.

Q. 113. What type of froth is produced by these conditions?

A. Under all of these conditions as far as stated, you get the same type of froth, one with the cell walls having a film of oil or oil rich solution next to the ore, and the cell walls are stabilized by the presence of the mineral, which makes the films more viscous and therefore more stable.

Q. 114. Is there any change in the type of froth at or about one-half of one per cent. of oil to ore?

A. There is absolutely no change in the type of froth at any such point.

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Q. 115. On what does this hypothesis of the critical point rest?

A. Well, that is a bit of an unkind question, but it seems to me that the hypothesis of a critical point rests on unverified and unverifiable statements.

Q. 116. Does the Cattermole phenomenon occur at any definite ratio of oil to mineral or oil to ore?

A. No, the Cattermole phenomenon does not occur at any definite ratio of oil to mineral or oil to ore. The Cattermole phenomenon, which is the granulation of the particles into minute lumps imbedded in oil, will take place at entirely different ratios either of oil to mineral, which is the proper way of putting it, or oil to ore, which is unfortunately the ordinary way of putting it, depending on the degree and manner of agitation; that is, it can be run so that you will get granulation when you have got relatively small amounts of oil, and it can be run with the same oil and the same ore, yet the granulation does not take place at those ratios. In other words, the important factor in there is not the ratio of oil to mineral, or the ratio of oil to air; it is the degree and manner of agitation.

Q. 117. Now, professor, Bancroft, will you summarize for the court your conclusions, with such references as are necessary to the illustrative experiments you have presented.

A. The question to be decided was first as to the type of froth that we have in the case of flotation and, secondly, whether this froth changed in type at any given ratio of oil to ore which, as I have said, is

a bad way of putting things because it does not represent facts, or of any ratio of oil to mineral. Consequently I began back with the simple question of oil and water, using oil again in the broad sense to denote an insoluble oil, so-called, a soluble frothing oil, so-called, or a soluble frothing agent, so-called. In all these cases we get the formation of a surface film at the interface between water and air which is more viscous than the mass of the liquid and consequently when beaten up with air, such a liquid foams or froths; and it does it under all conditions; and it foams and froths only, so far as we know, when the surface film is more viscous than the mass of the liquid. And to illustrate that we did the experiment with alcohol and water showing why certain concentrations do foam and certain other concentrations do not foam. In the case where they do not foam the surface film is not so viscous as the mass or the bulk of the liquids. Then the question comes up as to the type of froth that you ~~got~~ get when you have oil and water alone. Since we know that the oils absorb air more strongly than water does, we know that under these circumstances and with all ratios of oil to water with which we are working we get the same type of froth in which you have bubbles of air, since we are working with air. The films constituting the walls of the froth are either an oil layer, if you are using enough oil to give you a separate layer, or an oil-rich solution in contact with air. Now,

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go further into the film and you will get water containing less oil than in the surface film, and that part of it would be less viscous. Consequently we have the same type of froth throughout when water —when we have oil and water alone. And, as I said, so far as I know, that is not disputed as yet by anybody. Then these froths are—at least the froths that I was considering—are all more or less evanescent. That is, they break down very quickly; some of them break down extraordinarily quickly. If we make these films more viscous in any way we shall stabilize these froths and get froths of varying degrees of permanency, depending on the viscosity that we produce under these conditions. Now that can be done by means of a very viscous oil, and I cited the case of the oil mixture of the Butte & Superior Company where they have a relatively large amount, 70% of fuel oil, which I understand is a very viscous oil. And that does give, because I know personally, a more or less permanent froth without any other stabilization. On the other hand, you can stabilize the film by introducing into it a solid which will stay there because the presence of the solid in there increases the viscosity just as increasing the amount of ore in a pulp would increase the viscosity of the pulp. Then of course the next question is what substance will go into that film and will stay there? Any substance, any solid which is adsorbed strongly by the oil layer, by the oil-water interface or by the oil-rich solution,

will pass into that part of the film—The question of stabilization by means of a solid under these circumstances is absolutely independent of the chemical nature and origin of the solid except insofar as the chemical nature determines whether the substance will go into the film or not. That is, you may have the case where the mineral goes in and the sand does not. If you find a hypothetical oil which may exist, although I do not know of it, which adsorbs sand or gangue very strongly, then you could stabilize your film with sand or gangue. There would be no profit in it, but it could be done. Instead of hunting for that hypothetical oil, which would probably take a good while, it seemed to me it was simpler to take a number of different solids which could be made to stabilize certain froths and to show that under these conditions the chemical nature of the solid had absolutely nothing to do with the problem, and that the whole question was whether you had a solid which did go into the surface of the film. In order to show that I have taken—of course everybody knows it in regard to mineral—I have taken among others lycopodium powder, which is a vegetable product. As I said, it is the spore either of a moss or a fern, I don't know which—but I have taken white lead, which so far as I know does not occur as a mineral anywhere, and certainly the white lead that we used did not occur as a mineral, and I have taken lamp black, which is a different substance. The only rea-

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son for taking those things is that I think that I have read somewhere, although I cannot lay my finger on the reference, that somebody or other said that only those substances floated which were metals or were like metals; that is, in other words graphite, which conducts electricity metallically, and the crystallized sulphides which do look like metals—which have a distinct metallic luster. In fact I think in that same paragraph which I am certain I saw but I cannot find it although I looked for it, there was also a statement that they believed that precipitated zinc sulphide would not float because it was not crystalline and metallic. So, it seemed to be very desirable to try the experiment with substances which did not resemble metals in any respect; and I cannot see any way in which anybody could claim lycopodium powder or white lead as being similar, either in properties or origin to a metal. Personally I would not want to classify lamp black either under either head although of course it is carbon, one form of carbon, and graphite is another form of carbon. If anybody insisted that this was an immaterial point I would be willing to meet him half way on that although I should still think he was wrong. I have shown that under these conditions these things go into the film; further it is not a property of the particular substance in itself since we have selective adsorption. Mineral goes into an oil in preference to gangue. Consequently in the same way when we start with different soluble froth-

ing agents or oils we may get selective adsorption so that a substance which will stabilize one froth will not stabilize another. The lycopodium powder stabilized the pine oil, which is a soluble frothing oil, so-called and it stabilized the alcohol, which is certainly a soluble frothing agent; on the other hand lycopodium powder had no stabilizing effect whatever on acetic acid. That is, in other words, you are getting a selective adsorption; the lycopodium does adsorb alcohol and does adsorb pine oil to a sufficient extent to enable it to stabilize the froth, while lycopodium does not adsorb acetic acid in sufficient extent to give us a stable froth. In other words, the whole thing is selective but it is not, however, a peculiarity to acetic acid, that you cannot stabilize it. We know that we can stabilize an acetic acid froth by means of mineral and I showed that we could stabilize acetic acid by means of lamp black and I further showed that we could stabilize phenol by means of lamp black; that on the other hand, we could not stabilize phenol by means of white lead. I did not try white lead with acetic acid because the probabilities are that the acetic acid would react with the white lead. Now, I could have gone on, if I had had unlimited time and so had everybody else, and have worked up an indefinite number of other substances that would work exactly the same way; but it seems to me that lycopodium, white lead, lamp black and mineral are sufficiently definite to establish the principle that the

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nature of the solid is of no account, so long as it is adsorbed. Now, since the only function of the solid, from the theoretical point of view, is to stabilize the froth, and since it is the solid which is adsorbed in the surface of the film which stabilizes the froth, there can, therefore, be no change of type in the froth; and since the froth, in the absence of the solid, is all of the same type, that is with an oil layer or an oil-rich solution next to the air, it is still of the same type when you add the solid and there is not any possible way, so far as I can see, that the solid should cause that froth to turn inside out or to do any other laboratory tricks, and consequently we come to the theoretical conclusion that the type of froth does not change with varying the amounts of oil in there and that is confirmed by the experimental fact that when you make a froth under the different conditions as shown in the experiment with the three jars on the edge of the desk, you cannot possibly recognize any difference in type in these three froths, although one of them contained in round numbers 0.29 per cent of oil to ore; one contained .087 of oil to ore in round numbers, and one contained 1.45 per cent of oil to ore, also in round numbers. Further, then, the whole nomenclature seems to me rather footless, if you will permit me to use that word; that is, people talk about "the ratio of oil to ore". Now, except so far as the gangue goes up into the froth or the mineral goes down into the gangue, it is perfectly clear that the important thing in any particular case is the ratio of oil

to mineral and not the ratio of oil to ore; and that, so far as one can see, is also confirmed to some extent by mill practice where the operator is judging by eye the looks of the froth—perhaps I ought not to say that he is judging by the eye because I do not know that definitely—but anyhow it seems to be the practice that when the amount of mineral in the ore goes up, they add more oil. And of course I admit that there is a certain picturesqueness about expressing things in the ratio of oil to ore. That is if you take about one tenth of one per cent of oil to ore it apparently appeals to one's imagination that that is a very remarkable, striking thing, and a very low amount of oil in reference to the ore, which is true. On the other hand, if you figure that around as it should be figured in the case of the ore containing seventeen per cent mineral your ratio of oil to mineral is approximately six per cent, allowing for errors in multiplication and division, which is not half as impressive. If you go down further to the case of an ore containing four per cent mineral why, this same thing figures out 25% of oil to mineral, which is—well, that is beginning to be interesting again but on the other side. I cannot see any possible scientific justification for referring the amount of oil to the amount of ore because the important factor in there is the ratio of oil to mineral and it does not seem to me that mere picturesqueness is important, under the circumstances. On the other hand, I am quite willing to concede that this is a point on which people can very easily be misled because you can stabilize a

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given froth fairly satisfactorily with varying amounts of mineral and consequently it is possible to work with a given oil and a given ore and vary the ratio of oil to mineral over quite a range without necessarily getting bad results; and I think that that is possibly the reason why people have gone to pieces in this case and have laid stress on the ratio of oil to ore when they really meant the ratio of oil to mineral.

As I said, of course you get that most clearly in the unrealizable case where you have 100% recovery and concentrates, which, as far as I know, never occurs. You will get disturbing forces so that, when the froth is stiff, it will naturally entrap more of the gangue, and consequently give you a lower grade concentrate. When the gangue is very finely divided and consequently settles very slowly, that also will be a factor giving you a higher amount of gangue in the froth; on the other hand, when your gangue settles very rapidly, it is likely to carry down a certain amount of mineral with it. That mineral may be either entrapped mechanically, or it may be that you get an actual mechanical rubbing off of the mineral from the films of some of the bubbles. In fact in some of the photographs that were shown the other day you could see in places where the bubbles had come in contact with the face of the glass, that the mineral was entirely gone from them, and you got a shining film, the mineral being off at the side of the bubble. Now, the only other thing that comes in as far as I know here are some of the questions in connection with the feed. I have already stated that it

seems to be mill practice to increase the amount of oil when the mineral content of the headings runs up. When the amount of water in the pulp runs up, we have two factors coming in, the factor pointed out by Mr. Taggart, that we have a higher concentration of the mineral particles and consequently a greater possibility that they will not all become entrapped in the bubbles, and you have also the possibility that you dissolve out more of your frothing oil from your oil mixture that you are using, in case you are using an oil mixture, and that consequently you are working with what is analogous to a different oil. The differences, may not be very great, but it would be real difference. So that those are all factors which come in and disturb the situation. Then, of course, you also have the possibility of varying the nature and kind of the agitation, either by using a different machine, by stirring more rapidly, or by feeding in more air, and those things will all have their effect in changing the amount of froth and the quality of the froth; that is, going back simply to the case of oil and water, if you put that in a bottle and shake it by hand, which is a primitive and tiresome method, you can only convert a relatively small amount of oil over into bubbles for the same cross section of the bottle, because we do not shake it violently enough. On the other hand, if you take it with a more efficient stirrer, then under those conditions you can run up the amount of the oil in proportion to the cross section of the vessel and get a great deal more froth, as has been shown by these

things that we have worked here. It would have been quite impossible for me to have taken one of those glass jars, even if I had a stopper for it, and had shaken the oil and water in that and have produced the amount of froth that we could in the other case. Consequently the kind and nature and amount of the aeration will play a very large factor in determining what ratio of oil to mineral you can use safely, so far as I can see, you can vary the amount of oil to mineral over a very wide range and still get a froth—of course not the same froth, but identical in its properties—by simply changing the absolute amount of air that you pump in in a given time, and the way in which you pump it in. I think that covers pretty nearly all of the points, though not all.

Q. 118. If one has a relatively heavy mineral particle under water and coated with oil, and if an air bubble is brought near it, what will happen?

A. The air bubble will attach itself to the oil and will tend to raise the particle. If the particle is relatively heavy, the oil will neck out—the tensile strength of the oil is not high—and consequently the bubble will not raise the particle, but will pull off a small amount of the oil from the particle, and will go up as an oil bubble. Now, you can go on repeating that, and you will take off a little oil every time, a little more oil, and you will get down to the point where, instead of having a thick film of oil on the bubble with relative little tensile strength, you have a very thin film of oil, which under those conditions is both more viscous than the

mass of the oil, and also ~~a~~ of greater actual tensile strength, and then you will come nearer and nearer to lifting your particle. If that particle is large enough you cannot lift it under any circumstances; if it is of a medium size you will reach a point, by the removal of the oil, where you will be able to lift it. The smaller the particle is, the easier it will be to lift and the less oil it will be necessary to remove from it; so that, with a very small particle you can lift it and should be able to lift it even if it were oiled pretty thoroughly heavily, and with a larger particle you would have to get down to a relatively thin film of oil before you could succeed in lifting the particle.

Q. 119. When an air bubble meets an oil globule without violent agitation, what will happen?

A. Again the air bubble will tend to pick up the oil globule, and the oil, or some of the oil will pass around in the interface between water and air, just exactly as it does when you put oil down on a flat surface of water in a beaker in contact with air, and just exactly as was shown in one of the diagrams this morning by Prof. Beach. Now, the oil, of course, barring the influence of gravity, would tend to concentrate uniformly in a film around the air; under the influence of gravity, of course it could not be quite uniform; in fact it distinctly will not be uniform, and you will get more of the oil down at the lower end of the bubble; and since the thick film of oil—I am using thick without giving any definite limit to the size for a moment—is not stable, and consequently the oil will pull off, and

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you will have your air bubble with a thin film of oil around it, and the rest of your globule of oil will be drifting around wherever fate may take it; it depends on the arrangement of your apparatus.

Q. 120. Would it seem likely to you that these things you have stated might cause one to conclude that the air bubbles do not directly attach themselves to the oil globules, and have slight, if any lifting power?

A. Why, if a man were just simply doing the thing, without knowing very much what he was doing or without having any special theory either to guide him or hinder him, as the case might be, I think it would be a perfectly natural mistake for a man to make, and I would expect a man who observed those things and did not analyze them carefully, to draw exactly that conclusion. The conclusion would be wrong, however, in spite of its being a plausible one.

Q. 121. Does it seem probable that one might draw a conclusion that air bubbles do not attach themselves to metallic particles coated with sufficient oil to produce adhesion?

A. If you were working with a sufficiently large particle, that would be the natural conclusion to draw from the experimental evidence if you did not analyze it. It would be an inaccurate conclusion, for the simple reason that it is not so.

Q. 122. What would be the more accurate way of putting it?

A. Why, I should prefer to draw the conclusion

under those conditions, that the cohesion between oil and oil was less than the adhesion between oil and air, and that consequently when you put the strain on it, the break comes in the oil, and the bubble carries off a small amount of oil with it; which is exactly what it does experimentally.

Q. 123. Can you give any illustration of a similar nature from some other field?

A. Yes. If you take a solution of gelatine or glue in water—and of course glue is simply impure gelatine—and put it in a glass beaker and let it dry, it dries down to an apparently solid mass. If you allow that to dry still further by putting it in a very dry atmosphere, the adhesion of the gelatine to the glass is so strong, that even though you have got a smooth bottom in your beaker on the inside, that gelatine holds on to that so strongly that when you take it off it pulls pieces of glass off of that surface. The experiment does not always succeed, because sometimes it breaks the beaker all to pieces, simply doing it a little more; but when you get the thing going, where you get it finally with a gelatine film that has torn pieces of glass right out of that surface—you can conceive what force it would take to break little pieces of glass off the smooth surface of the window pane with your fingers —it gives one a realization of the force that may be acting in the case of a surface film where you have two different substances. Of course I do not mean to say that your oil film could, under any circumstances pull pieces out of the mineral particle, even

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though the mineral particle were large; but it does bring out this other point.

We have another instance of much the same thing in a glue joint. If you glue two pieces of wood together in a careless way with a pretty thick glue joint in there, then under those circumstances the strength of one part of the glue to the other does not amount to very much, and the thing will break at the joint every time. If you do that thing in an honest, workmanlike manner, with your glue warm, so that it goes into the wood a little, and do it with as little glue as you can, and press practically all of the glue that there is there out, so that you have the merest thin film of glue between the faces of the two pieces of wood, then you will get a joint, which, when it breaks, will usually break somewhere else. Of course if the thing which you were to glue were two trees, butt to butt, I imagine under those conditions probably if they broke that they would break at the glue joint; but under ordinary conditions that arise in cabinet making for instance, a first class glue joint is stronger than the wood. That is not a question of mill practice; that is actually experience.

Q. 124. If air bubbles are produced in pure water, would you expect them to be large or small?

A. I am assuming that you are having your bubble produced from a tube or some other orifice. The size of the bubble produced under those conditions depends on two things; first, the size of the opening, secondly the surface tension of the liquid in which the

bubble is produced. If you stick to the same sized orifice, you would get a larger bubble the higher the surface tension of the liquid, and as you are dealing in this particular case with water, you would get relatively large bubbles. Of course that does not mean that if you worked with an infinitely small orifice the bubbles will be as large as a balloon, but they will be much larger than they would be if you worked in another liquid which had a lower surface tension, because those two things, the size of the orifice and the surface tension of the liquid are the two forces which determine the size to which the bubble may grow before it tears loose.

Q. 125. If anything were added to the water which reduced its surface tension, would you expect the bubbles to become larger or smaller?

A. They would of course become smaller, because that is one of the very nice and satisfactory methods of determining the relative surface tensions; that is, you take a glass tube of a given size, and you let air bubbles out of that into different liquids, and you will get the largest bubbles in the liquid, as I have just said, with the highest surface tension, and in the liquid with a lower surface tension you get smaller bubbles, or with the same liquid if you have added something to it which lowers the surface tension, you will get smaller bubbles, and that is the—is one of the recognized ways —one of the easy ways of getting a qualitative test of the relative surface tensions. You may also go at it around the other way, of course, by letting the liquid

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run out of the orifice. For instance, let the liquid run out of a burette either into the air or into another liquid, depending on what you want to study. If your liquid has a high surface tension your drop will grow to a relatively large size before it breaks off from the burette. If it has a low surface tension you will get a much smaller drop, or if you take a liquid and do anything to it, add soap or saponin or salt or something of that sort, your drop will be larger or smaller depending on whether the surface tension is increased or decreased, and in that way the thing can be used as a quantitative method of determining the surface tension, that is, you weigh the number of drops, or a given amount of the liquid, and work back from that to the surface tension. Under ordinary conditions that is not very accurate, because the theory calls for a drop which breaks off cleanly and leaves nothing behind, but if you run a burette or anything of that kind, we know that under ordinary conditions you get a drop coming off, not clean; there is a small drop left behind. It has been shown by Morgan of Columbia that if you use—I don't know the exact conditions, but if you use a tube with a bevelled end, instead of a tube that simply comes down square, under those conditions a clean drop is removed, and he has used that as a quantitative method of determining relative surface tensions of different liquids and different solutions. So that, of course, you would get a smaller bubble in case you added anything to the water which lowered the surface tension, and conversely you would get larger bubbles if you added

anything to the water which increased the surface tension. That is first principles.

Q. 126. Do oleic acid, phenol, cresol and amylacetate lower the surface tension of water?

A. They do.

Q. 127. If bubbles generated from small orifices —in solutions of these substances, might we get an effect which could be described as smoke?

A. I see no reason why you should not. If we have a very fine orifice the bubbles in themselves will be small; and if we add to the water anything which reduces the surface tension, your bubbles will be smaller still, and consequently it is merely a question of how small your orifices are what your definition of smoke is, whether you would call the thing a smoke or not, but I can not see any reason why you should not get a cloudiness in there which could perfectly legitimately be called smoke. I never tried the experiment, but it sounds perfectly reasonable.

Q. 128. What can you say about the liquid film in contact with the air of the bubble?

A. Well, I have been trying to say that a great many times all day, that in all these cases you have either an oil layer or an oil-rich layer next the air, and that—if you do not want to use the word "oil"—if you have phenol in solution, th~~en~~at the film in immediate contact with the air will be higher in phenol than the mass of the liquid. The same thing will be true of

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cresol and with amylactate and with anything else of the same type that may come up.

Q. 129. Do you agree with the proposition that mineral frothing agents are generally not oils or oily in character, so it is a ~~and which use the~~ mere incident that oils are also mineral frothing agents—the word mineral being used to mean metallic sulphides?

A. I should think that was a very misleading statement. In a sense, of course, it is perfectly true; that is, in the narrow sense of the word, you don't call acetic acid an oil; that is, in every-day life, acetic acid is not called an oil, and consequently to that extent it is justifiable. On the other hand, the practice in flotation matters is to call everything an oil which tends to show a selective adsorption for mineral as opposed to gangue. Now, that may or may not be a good thing to do, but it is the regular and established practice, and consequently when one is talking about flotation, acetic acid is an oil, and while it is perfectly legitimate anywhere else to say that acetic acid is not an oil—I should not classify acetic acid under ordinary conditions as an oil—it certainly is an oil under the established usage and customs of flotation matters, simply because it is better to call all things by the same name when they behave in the same way. In regard to the selective adsorption of mineral with reference to gangue, you get that with oils, with soluble frothing oils and with so called mineral frothing agents, as defined by Mr. Williams—they all behave in exactly the same way; in other words, they all show selective adsorption,

and consequently they are all oils, and consequently under that nomenclature acetic acid is an oil and the statement is inaccurate. You can not judge a statement of that kind except with reference to the context, and it is perfectly true under some circumstances and it is absolutely false under others. That is why I prefer to classify that as a misleading statement.

Q. 130. Would you expect that air bubbles disseminated by a suitable agitation in the presence of a soluble frothing agent, would search out mineral particles from the ore pulp, pick them up and carry them to the surface, leaving the gangue?

A. I don't see how they could be expected to do anything else, because by your definition of a soluble frothing agent, it is going to have a selective action, and that seems to me simply—I may not have understood your question, but it seems to me like saying the thing right over and over again.

Q. 131. In these cases are the air bubbles in direct contact with the mineral particles?

A. Again that is the same question; they are not. Under those conditions you have—you might say—an oil layer—the oil layer you have is different, because it does not come out as an oil—you have a relatively oil rich solution in contact with the air throughout, and you do not have any contact between the solid particle and the air under these circumstances.

Q. 132. Is it possible to have direct attachment of your air bubble to a mineral particle?

A. Theoretically I think it is; that is, we know that

in the case of so called minerals, zinc sulphide and lead sulphide, they do generally adsorb air markedly. The reason we know that is because they are not wetted readily by water, and since the air is adsorbed markedly, there is no reason why you should not have direct contact between the sulphide and the air, and there is no reason why under suitable conditions you may not have an air bubble in contact with the mineral and actually lifting it. On the other hand, you may not have that, if you have present in your water either an oil—either an insoluble oil or a frothing oil or a soluble frothing agent. In other words, the thing is perfectly possible theoretically; I should not think of disputing it. Whether it occurs in any given case or not is a matter to be decided with reference to that particular case.

Q. 133. When mineral particles are apparently lifted by the air, is it certain that that is really happening?

A. No, I don't think it is, because there is always a possibility that the mineral particles are not clean in the beginning; that they may have had on their surface either oil or greasy matter from somewhere, and that consequently under those conditions one was not dealing with the direct contact of air with mineral. That would all depend, as far as I can see, on the degree of care with which the experiment was carried out, and I should not be willing to accept the mere statement that one had a contact between air and mineral as conclusive unless the thing were shown to be

so. It is perfectly possible that you may have it, but it is equally possible that experimental errors may come in. Even I can not do my experiments and make them come out right every time.

Q. 134. Have you any independent evidence to confirm your statement on this subject?

A. Yes. If you take a piece of mica and split it into two pieces or two plates; now, if you press those pieces together any time within three or four minutes, the thing will go back and make practically one piece of mica instead of two. If, on the other hand, you wait more than three or four minutes—say if you wait ten or twelve minutes, then you can not possibly press those two pieces of mica together and make them weld into one by any pressure that any ordinary man can exert with his thumb and forefinger; which shows that during the ten minutes that those fresh mica surfaces had stood exposed to the air, that something—a film of air or a film of water or a film of grease had condensed upon them, so that when you press them together you do not really bring the things into intimate contact.

Now, there is another rather interesting thing about that. Lord Rayleigh states that the film which forms film on the surface of the mica conducts electricity, and therefore he concludes that it contains water; that is, in other words, that it is chiefly or partly moisture condensed from the air; that in the course of a few hours —I don't know how many—but in the course of a few hours, instead of having a conducting film on the sur-

face of the mica which conducts electricity, you get a non-conducting film, from which he draws the conclusion that it is due to adsorption on the surface of the mica of grease or oily matters from the air.

Now, of course in view of that thing which we know in the case of mica and which can be determined experimentally and has been determined experimentally, it seems to me very doubtful whether any particle of mineral which has been exposed to the air, unless extraordinary precautions have been taken, should be free from grease or oily matter, and for that reason it seems to me very doubtful whether anybody has ever shown the actual lifting of a mineral particle by direct contact with air, although I am perfectly willing to admit the theoretical possibility. In fact, I would go further, and say that theoretically it is unquestionably possible, but one would have to consider in any particular case whether the man who did the experiment had taken enough precautions to prevent the contamination of the surface, which would certainly take place very readily if the particle was exposed to air.

Q. 135. Do you know of anyone ever having performed any such experiment, taking the precaution which you have described to avoid contamination of the particle?

A. I don't know of any experiments that have been performed where the necessary precautions have been taken.

Q. 136. Is it true, then, to say that in the agitation froth process, the froth, and the single bubbles, there-

fore, consist of metallic particles held to air bubbles by direct attachment?

A. It is not true. In all those cases you have an oil layer or an oil rich solution in contact with the air, and the particles are in the oil film or at the oil-water interface, or in the oil rich solution, depending on which particular case you are studying. I do not see any possibility under any circumstances where you can have direct connection between air and a particle in the presence of any of these so called frothing agents, and I do not believe it occurs.

Q. 137. Do you consider the proposition correct or incorrect that the fundamental principles of flotation are air entrainment and the increased affinity of air for metallic particles in the presence of a frothing agent?

A. It is perfectly right to say "air entrainment" if one knew what it meant. If you mean that an important thing in flotation is the formation of bubbles containing air, that part of the statement is true. The other part of the statement, that an important factor in flotation is due to the increased affinity—

Q. 138. The increased affinity of air for metallic particles in the presence of a frothing agent?

A. The statement that the "increased affinity of air for metallic particles in the presence of frothing agents" is an important fact in the flotation process seems to me absolutely and hopelessly wrong because, as I say, you never do get, under these circumstances any contact between the air and the particle. If you

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did, it would be a very important and a very interesting thing, but you don't do it.

Q. 138½. If you were told that when a bubble lifting metallic—if you were told that when air bubbles lifting metallic particles, met the thinnest possible oil layer they dropped the particles, how would you account for it?

A. Well, I would account for it, I think in two ways: in the first place, I should account for it by saying that if the bubble hadn't any viscous film it would of course burst and the particle would be dropped back into the oil where it would either be held up by the bulk oil process, or it would not, just as the case might be. That would depend on the size of the particle. The other way of accounting for it, which seems to me to be simpler, is to say that I know that it is not so because I have seen a particle lifted up with an air bubble in a bubble holder through an oil film. I admit it is not an easy thing to do experimentally, and one might easily fail twice in three, but I have seen the particle come up. So that under this condition I don't quite see why I should be expected to account for its not coming up.

Q. 139. What would you call a froth made by agitation at about 1800 revolutions per minute ~~second~~, 80 c.c. of water at 70°, 16 gms. Broken Hill tailings, .6 c.c. 20% sulphuric acid and one drop of oleic acid, which would be between one tenth and two tenths of a per cent on the ore?

A. Well, I would much rather have that put in terms of oleic acid to mineral, because, as I have tried

to point out, that is the only rational way of doing it; but of course that hasn't any bearing on the experiment. I should say there can be absolutely no question but that that would give you exactly the same type of froth that we have been discussing ever since we came here; that is a froth in which you have an oil layer or an oil-rich solution in contact with the air.

Q. 140. In your judgment would it be proper to call such a froth an air froth, meaning thereby that the air is attached directly to the mineral particles?

A. It would not be proper to call it that because that is not what happens; and it is a great deal better, it seems to me, to stick to facts.

Q. 141. Is it possible to obtain a so-called oil froth in which there are oil globules, with the mineral distributed entirely through the globules, with skins of dividing water partitions between the oil globules and with particles of air entrained between the globules?

A. I don't see any difficulty about doing that. Suppose you were to take the bulk of oil process and shake up the oil until you get some of the oil down in the bottom of the beaker, let us say, if we are doing it in a beaker, as oil globules. Now, these globules might or might not contain particles of mineral—it could perfectly well be arranged so they would, I imagine, so that all of these would. Down there, you have all globules containing mineral particles inside of them, separated by either thick layers of water, if you only had one or two globules, or by thin layers—which you could call films, in case you had a great many down under this condition. Now, I see no difficulty whatever

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in blowing in air,—I don't know that you could do it —I never tried it, but I don't see any inherent reason why you should not blow in a small amount of air, avoiding marked agitation, so that the air bubbles would cling to the oil and you would then have an oil globule containing mineral separated by watery films and containing air—did you say "entrained" or "entangled"—whichever it was, between them. Now, that is starting with a lot of oil. Of course, if you start with small particles, either a single particle with a little oil around it, or if one performed with a granulated particle, Cattermole effect, with oil around that, under this condition—under these conditions your granules would have particles with oil around them and no air. And now if you had enough of that and the ratio of solid to oil was not too high and if you got air entangled in them in the same or similar way, I see no reason why they might not float up to the top and give you, on the surface, oil globules with particles of mineral entirely inside the oil, with water films separating the globules and with air bubbles scattered around more or less frequently through the oil. I don't know whether I can do the thing experimentally, but it seems to me—that is I don't know it from my own personal knowledge—but I do not see any conceivable reason why it should not be done if anybody wanted to do it. I think I can do it myself if I had to.

Q. 142. Well, would such, a so-called oil froth be identical with the froth obtained in the agitation froth process?

A. Why, no, of course not—absolutely not, different in every respect.

Q. 143. Is this so-called oil froth that you just described in one of the previous questions a true froth?

A. No, it is not a true froth at all, because it does not come under the definition as given. Of course every man has a right to make his own definition, but afterwards he has got to live up to it; and the definition that I made which I think is the definition that would be accepted by pretty nearly everybody—probably with slight changes in wording—I don't care about that—is that a froth is a closely packed mass of bubbles having a honey-combed structure with the cell walls composed of liquid films and the individual cells filled with air or other gas. Now, if anybody is going to be hypercritical I will modify that. Of course when I say, "honey-combed structure" I mean what anyone would under ordinary conditions. I do not mean that a cross section of one of those bubbles is actually hexagonal in shape as is the case of a honey-comb of a bee, but I am using the word "honeycomb" in the ordinary way in which the word is used.

CROSS-EXAMINATION.

BY MR. WILLIAMS:

X-Q. 144. Professor, you mentioned an article as having first attracted your attention to flotation, Swinburne's article?

A. I did.

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X-Q. 145. And I thought you had the article at the time?

A. I did.

X-Q. 146. May I look at it?

A. Certainly, with great pleasure. I supposed you had seen it.

X-Q. 147. The discussion in this article is of the so-called Potter-Delprat process, is it not?

A. I think that is what it is. I so understood it, although he carefully avoids putting it in that way. That is my recollection of the article, that he says he is going to discuss it from a purely scientific point of view without any reference to any definite—or without any specific reference to any definite process. As a matter of fact, however, I think your statement is perfectly correct.

X-Q. 148. I understood you to say during your testimony that Dr. Adolf Liebmann had said that a phenol when present in water in such proportion that it was not dissolved was an oil? Where did you take that statement from?

A. I did not make that statement in exactly that form. As I understood you, you read it that I said that "a phenol." My statement was that phenol—of course it comes to the same thing, but there are a number of substances which are phenols. I can give you that reference in a moment or two. I think I have it in my notes. You will find it in the third volume of the Miami transcript, page 1852. I think I quoted it correctly. I verified the quotation.

MR. WILLIAMS: If your honor pleases, I would prefer to read over the deposition of Professor Bancroft before the cross-examination, thereby hoping to save considerable time.

THE COURT: That hope springs eternal. Well, it is five minutes of five and we will adjourn until 10:00 o'clock tomorrow morning.

WHEREUPON an adjournment was taken until Saturday, April 28th, 1917, at 10:00 a. m.

Saturday, April 28th, 1917, 10:00 a. m.

WILDER E. BANCROFT resumed the stand for further

CROSS-EXAMINATION

BY MR. WILLIAMS:

X-Q. 149. Reading from your testimony of yesterday, in your answer to Q. 34, you said, "Dr. Adolf Liebmann said that when you add a small amount of phenol, so that it is all dissolved in the water, it is a soluble frothing agent, but if you add an excess of phenol it is an oil, therefore of course would come under the head of partially soluble oils." I have read the part of the testimony of Dr. Liebmann in the Miami suit to which you gave me specific reference as authority for that statement, page 1853, and it seems to me that you have not quite accurately stated what Dr.

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Liebmann says; so I will call your attention to Dr. Liebmann's testimony, answer to X-Q. 249, and ask you if you wish to correct that statement. (Handing witness copy of testimony.)

A. He says that phenol is a soluble frothing agent, and he says here at the top of the page that an excess of phenol is an oil, and he says, in the answer to question 2051, "I say it is phenol as an oil." I don't see any reason for modifying that statement.

X-Q. 150. Well, the differentiation which occurs to

P. 3211, L. 13, insert "as an oil", and wherever he repeats it he always says", after (:)

X-Q. 151. Do you accept that correction?

A. No, I do not. In 2049 he says, "Now, that excess of phenol over and above the amount that will go into solution, in what condition does that exist? As an insoluble substance, as an oil; it exists as an oil." He does not say that it acts as an oil." I don't see any reason for modifying that statement.

X-Q. 152. Then I will read the full statement so that we may have a comparison. "X-Q. 2049. Now, that excess of phenol over and above the amount that will go into solution, in what condition does that exist? A. As an insoluble substance, as an oil. X-Q. 2050. As phenol or as some hydrate that exists there? A. It is an oil. Q. 2051. Does it still exist as free phenol, or does it form some combination with the water? A. I say it is phenol as an oil. Q. 2052. Well, this excess

over and above what is in solution is still simply phenol? A. Yes." I think that covers it?

A. I think it covers it, yes.

X-Q. 153. That is the correct reading of the testimony, is it not?

A. Absolutely correct.

X-Q. 154. Now, dipping a piece of galena, for example, into a particle of insoluble oil, some oil is removed by withdrawing the galena from the oil, is it not?

A. It is.

X-Q. 155. What is the condition of that oil; does it become attached to this metalliferous particle?

A. If you mean—what do you mean by what is the condition? It is oil.

X-Q. 156. What holds it to the metal particle?

A. It is adsorbed by the metal particle.

X-Q. 157. Does it adhere to the metal particle?

A. I should prefer to say that it is adsorbed by the metal particle because that is more accurate.

X-Q. 158. What is the thickness of the coating that you get around the metal particle in thus dipping it; does it—it gives you what measure of adsorption layer?

A. By adsorption layer do you mean the thickness or the force with which it is held, or what do you mean?

X-Q. 159. Well, we will take thickness?

A. The amount of oil that will be on the surface may vary with the conditions of the experiment from a very small amount up to an amount—a thickness which

would drip off, depending on the way in which you hold it. I don't see any way that you could get a thicker layer than the amount that would drip off.

X-Q. 160. Would the amount that would not drip off be an adsorption layer?

A. I think you could call it that—that oil would be adsorbed.

X-Q. 161. All of it?

A. All of it, I think.

X-Q. 162. What is your authority for that statement?

A. I think I would prefer to quote myself as authority for it.

X-Q. 163. Is there any other authority?

A. For the existence of adsorption under the conditions that I have stated?

X-Q. 164. Yes.

A. I don't remember whether anybody who has written a book on colloid chemistry has discussed the specific case of oil and galena. I can not see why anybody should have taken it up, and I don't remember that they ever did.

X-Q. 165. That thickness of the oil layer that would not drip off would vary with the viscosity of the oil, would it not?

A. Yes.

X-Q. 166. With a viscous oil, would it still be an adsorption layer?

A. That would depend on how you looked at it. Personally, I should consider that as an adsorbed layer

because the oil is adsorbed at the surface between the galena and the oil; and as long as the rest of the oil is there I think it would be less confusing to call it an adsorption layer. If you prefer to put in any other definition I would be glad to discuss it in terms of your definition.

X-Q. 167. Do you recognize any difference between adhesion and adsorption, as applied to the terms that I have stated?

A. Yes, adhesion and adsorption are two entirely different things.

X-Q. 168. I would like you to define the difference.

A. Adhesion is the holding together of two dissimilar substances, whereas cohesion is the holding together of two parts of the same substance. Adsorption is a surface condensation or concentration as the case may be, and of course involves adhesion, but the two are not identical. That is, you have got to eat to live, but eating is not necessarily living.

X-Q. 169. Well, can you point out the difference in the instances that I have given, where a coating of oil adheres to a metallic surface, and, as you put it, a coating of oil is adsorbed on the metallic surface.

A. When it is adsorbed, then of course it adheres, but the two are not the same, although both take place or may take place simultaneously; but as a result of the adsorption that substance adheres to the underlying particle.

X-Q. 170. Can it adhere without adsorbing?

A. I do not know, but I think not.

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X-Q. 171. Now, in the instance of a highly viscous oil, you would get a thicker layer, wouldn't you?

A. You would get a thicker layer, yes.

X-Q. 172. It would adhere to the metallic particle?

A. It would.

X-Q. 173. And, by reason of its viscosity, a thick, comparatively thick layer, would be obtained; is that right? A. Yes.

X-Q. 174. The adherence would be the result of a force, would it not, ~~or the result of the molecular force~~?

A. It would result from the fact of the adsorption. If it were not adsorbed, as I said, I think it would not adhere.

X-Q. 175. But it would be the molecular force would it not, or the result of the molecular force?

A. I would prefer not to talk about molecular force, because there you go off into a realm where you can speculate as much as you like without getting anywhere. I prefer to stick right to the terms that I used, that it is adsorbed. Why it is adsorbed I do not know, but it is a fact that at the surface of any solid or liquid, you tend to get adsorption of a gas, or a liquid or of a solid as the case may be. And, that that adsorption is selective and varies with the nature of the solid, the liquid and the gas.

X-Q. 176. Can you give me an exact definition of adsorption?

A. Adsorption is surface condensation or concentration.

X-Q. 177. THE COURT: Would you say it takes place within the solid, too?

A. You can have an adsorption of a solid by another solid. For instance, for polishing metal we often use rouge in water, and there the rouge acts as an abrasive and polishes the surface of the metal. If, by any accident you let the rouge get dry, you will find that it will adhere very firmly to the surface of the metal and will spoil the polish. You have another case of it, of a similar sort, in impure mercury, where mercury flours. That may be due to the adsorption of grease—perhaps you wouldn't want to call grease a solid—or you may have it with an oxidized film. The case I cited the other day of a dry glue with the glass, the glue could not pull the splinters out of the glass unless it were adsorbed by it. Of course one might say that dried glue is a liquid and not a solid, but in the case of the rouge you have an unquestioned solid.

X-Q. 178. MR. WILLIAMS: In that oil layer whether we have adsorption or an adhesion resulting from an adsorption with a viscous layer or with any layer, there would also be cohesion, would there not?

A. Certainly, between any two thicknesses or portions of the oil you will have cohesion.

X-Q. 179. That is between the molecules and like substances there is cohesion? Am I accurate?

A. I didn't say that, no.

X-Q. 180. Well, then, please define cohesion as you would like to define it.

A. Cohesion is the holding together of two parts of a like—of the same substance. I did not say anything about the molecules; I dodge molecules wherever I can.

X-Q. 181. What are the reasons for your opinion that in the instance that I have given you there is a surface concentration of the oil?

A. Because under all circumstances so far as I know, where you have two surfaces in contact you do have an adsorption or surface concentration of something there. That is, so far as I know, no surface can exist without adsorbing greater or lesser amounts of something. What that will be depends on conditions. You may have a surface adsorption of a gas, of a liquid or a solid; but you have no surface that does not show a certain amount of condensation, so far as we know.

X-Q. 182. Now, in the instances that I have given you, what was the thickness of the layer in which adsorption occurred?

A. I do not know; your layer may vary from a very thin one up to a distinctly thicker one. I do not see that there is any way in which you can speak of the different thicknesses of your adsorbed layer without describing your terms a great deal more accurately than you have yet done.

X-Q. 183. Have you made any measurements of the thickness of the adsorbed layer of oil on metal?

A. I have not, but I can give you all the references to them if you want.

X-Q. 184. I have The Chemistry of Colloids, by W. W. Taylor.

A. I recognize the book.

X-Q. 185. Will you take the statements in that book as fair statements of authority?

A. No, I will not; not unless they are verified, because the book is a very bad book, written by a man who did not know his subject and who has arranged his subject in the worst possible order. Anyone writing a book on colloids should begin with adsorption; while, if my memory does not fail me, he puts in a chapter on adsorption over towards the end of the book. It is written by a man who had very little knowledge of colloidal chemistry, who had done very little work. It represents an especially bad instance of hack work. Of course, I do not mean to say thereby that everything in it is wrong, because that would not be true, but you can not place any reliance on any statement in that book because the author put it there. If it can be checked independently, well and good.

X-Q. 186. I will ask you to read that short paragraph on page 26, "Thickness of Adsorption Layer."

A. Out loud?

X-Q. 187. No.

A. I have read it.

X-Q. 188. Will you accept that as authority?

A. As authority in regard to what? On adsorption layer?

X-Q. 189. Yes.

A. He is not talking about adsorption layer. There isn't any adsorption layer here. He is talking about the

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behaviour of water or any liquid, and not necessarily in the presence of gas or vapor, which would be adsorption; and the surface layer that he is discussing under these conditions is not the adsorption layer that you would have in case you had either vapor or gas. It is an entirely different thing.

X-Q. 190. Suppose you give me some of your authorities.

A. For what?

X-Q. 191. Thickness of the adsorption layer.

A. Certainly—hold on a minute. I said there wasn't any such thing as a definite thickness of your adsorption layer. I can give you the minimum values under certain conditions at which the adsorbed film can be detected, and I can give you various other values, but I can not give you any definite figure for the thickness of an adsorption layer, because there isn't any such thing.

X-Q. 192. I so understood it, but you can give some indication of it. Please do so.

A. Minimum values.

X-Q. 193. I think perhaps you had better start with the minimum values?

A. The minimum value that has been accurately measured as affecting the properties of the substance in question is of the general order of one one-hundred millionths of an inch, or three ten millionths of a millimeter.

X-Q. 194. Now can you give us the range of the adsorption layer?

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A. The ~~storage~~ range of the minimum values?

X-Q. 195. No, the range of values within which the adsorption action is manifested?

A. No, I can't give you that.

X-Q. 196. How far can you go above the minimum?

A. I can give you, as I said, different minimum values; for instance I have here the smallest visible—the thinnest visible oil film is of the general order of one one hundred millionths of an inch. The oil film which is thick enough to change the surface tension of water is three times as thick as that. The film of albumin which is just thin enough to give you a so-called solid film on the surface is ten times as large as that, and we have other data of the same general order—those representing the minimum thickness.

X-Q. 197. And you are talking now of a film on the surface of water?

A. The figure which I gave there was for the thinnest film of oil on the surface of water which can be detected by optical means, and is one one hundred millionths of an inch, or thereabouts. I can give it to you in millionths of a millimeter, if you prefer.

X-Q. 198. I would rather have it in inches?

A. Well, in round numbers it is of the general order of one one hundred millionths of an inch, unless my arithmetic is bad.

X-Q. 199. And when you get to the amount of film which will affect surface tension, as I understand you, it is in what figures?

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A. Just about three times as large as the minimum one that you can determine.

X-Q. 200. And what is the book you are referring to, and the page, please?

A. The page from which I took those data is page 278 of the book to which reference was made the other day, Freundlich's Kapillar Chemie.

X-Q. 201. And that book is a book that you would refer to as an authority?

A. Oh, dear, no. I would not refer to any book as authority. I am merely quoting the references which he gives, and I am not quoting them on the authority of Freundlich at all. These are simply the measurements given by certain observers, and I shall be happy to give you their names if you like, and they represent their conclusions. I do not guarantee the accuracy of them in any way, but simply they are the best available information, and they are probably not very far wrong.

X-Q. 202. Is surface tension due to molecular force?

A. I suppose in a sense you can say that everything might be due to molecular force. I would not commit myself on the subject at all; I would simply take it that we have surface tension as a matter of fact, and I don't care at all how you get it. You see as a matter of fact you can get exactly the same results experimentally and quantitatively whether we consider that as something analogous to a surface film, like a rubber band, more or less roughly, or whether we consider that we are dealing with an internal pressure, the particles of the liquid

tending to go to the center—those two things are fundamentally different conceptions, but they lead, as far as I know, to exactly the same numerical results in regard to surface tension, and you can take one or the other as a working hypothesis to account for it, to suit yourself. There is no way that I know of of distinguishing between those two hypotheses, and consequently it is a great deal better to take your facts as you have them, and not as thev might be.

X-Q. 203. I did not put any hypothesis to you?

A. Oh, yes.

X-Q. 204. I put the simple question, whether surface tension was due to molecular force?

A. That is a hypothesis.

X-Q. 205. I ask you the question, is surface tension due to moelcular force?

A. I can't answer that—I don't know.

X-Q. 206. Is adsorption due to molecular force?

A. I don't know. That is merely a question of definition.

X-Q. 207. Well, that is enough.

A. Certainly.

X-Q. 208. Mr. Kenyon has called my attention to the fact that in that part of Dr. Liebmann's testimony which I quoted, I should have read the next question, commencing page 1853, X-Q. 2053. "It is nothing else; it is simply phenol? A. It possibly contains a trace of water. It is a remarkable thing that phenol by itself forms cresylate, melting at about 45 per cent;

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that is, it liqu~~i~~efies, but the part that is absolutely insoluble has the qualities of oil, you must remember, with the water." I have read that correctly, have I not?

A. You have read that correctly.

X-Q. 209. Now, has your study of the process that is here involved included—have you seen the process here in suit operated on a commercial or continuous scale, and if so, when and where?

A. You mean this agitation froth process?

X-Q. 210. Of ore concentration?

A. Well, I strolled casually through the plant of the Butte & Superior Company the first Sunday afternoon that I was here.

X-Q. 211. About two weeks ago?

A. It must have been Sunday the 15th, I think, and that is the extent of my knowledge of the technical process, if you can call that an extent.

X-Q. 212. Now, I show you an article printed in "Metallurgical and Chemical Engineering," dated June 1st, 1916, pages 1631 to 1635, entitled "Ore Flotation," a paper read at the joint meeting of both sections of the American Institute of Mining Engineers and the American Electro-Chemical Society, on May 12th, 1916, by Wil~~bur~~der D. Bancroft. Is that the paper that you read at that society at that time?

A. It is, or rather this article is based on what I said there. I do not mean to say that I said everything in the talk that is in here, or vice versa, but this article is an article based on that lecture, written up from my

lecture notes, so that I imagine it gives substantially what I said at the meeting, but as I spoke from notes only, I would not want to guarantee that.

X-Q. 213. I notice at the end of the article the words "Cornell University." Apparently as though this were something that was written at the university and reprinted. Of course, I merely want to refresh your recollection about the matter?

A. Not at all. I always put Cornell University at the end of all articles that I write; I would do it even if I were to write an article out here before I went home—which I am not going to do, by the way.

X-Q. 214. Well, you wrote this?

A. I wrote this, certainly.

X-Q. 215. Now, I read from this article as follows—do you want to follow me?

A. Well, I should like to have a copy; it will be easier to follow it; in fact I should like to keep it, because I haven't a copy myself.

X-Q. 216. We can spare that one; you may have it.

A. Thank you.

X-Q. 217. "When discussing the theory of ore flotation people are apt to lay more stress upon surface tension in general and upon contact angles in particular. While this is entirely legitimate, it seems undesirable, because we cannot measure a contact angle with any accuracy, and because the actual existence of a contact angle is a matter of doubt." Have I read that correctly?

A. You have.

X-Q. 218. Was that your opinion at the time that you wrote this article?

A. It was.

X-Q. 219. Is that your opinion now?

A. It is.

X-Q. 220. I will now read also from the article a foot note, referring directly to the part that I have read: "Rayleigh Scientific papers, three, 354, 1902." That is correct?

A. That is correct. I should like to add one statement, which may or may not have a bearing on this. I wrote this article, but I did not read the proof of it, so that it is possible that there may be some typographical errors. I don't know that there are.

X-Q. 221. From page 634 of the article I read as follows: "So far we have been considering the case where we have a fair amount of oil. If we cut the amount of oil down (almost to the vanishing quantity), another factor comes in, namely, air flotation. When sufficient quantities of oil are used the air floats the oil and the oil floats the ore. The ore is enclosed in a drop of oil having the properties of the matter in mass, and sinks to the bottom of the drop of oil, distorting it to a greater or lesser extent. If the amount of oil is decreased sufficiently we no longer have an oil drop surrounding the particle of ore, but an oiled particle, the lower part of which is, or may be in contact with water, while the upper part is in contact with air. We are, therefore, getting air effect in addition to the oil effect.

I do not know the relative importance of these two effects, but it has been claimed—and disputed—that modified air flotation is very much greater than the other." Have I read correctly from your paper?

A. You have read correctly.

X-Q. 222. Did that at that time represent your views, your opinion?

A. It did.

X-Q. 223. Is that your opinion now?

A. I think I would word that a good deal differently now.

X-Q. 224. I will read further, and immediately following what I read: "In the Wood & MacQuist~~o~~en processes there is no doubt that the separation would be more effective if it were possible to cover the ore particles with a thin covering of stearin, leaving the gangue particles uncoated. It is very difficult to wet the stearin coated commercial copper and aluminum powders, and it is therefore very difficult to make them sink under water. In modern processes of ore flotation using very little oil per ton, you get a thin coating on the ore, analogous to the stearin coating on the copper or the aluminum powder. It is possible that the air film may surround the oil particle completely, so that the oil does not come in actual contact with the water. In that case we are back to a straight air flotation of the oiled particles. This point calls for further study, because, if established, it will have a very important bearing on the future development of the subject." Have I read correctly from your article?

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A. You have.

X-Q. 225. Did that then express your views?

A. It did, but it does not now.

X-Q. 226. Does it now?

A. It does not.

X-Q. 227. I will read further, immediately following: "It is under these circumstances that the addition of more oil causes the ore to cement together and to sink. The reason for this will perhaps be seen more easily if we consider the analogy of sand and water. When enough water is mixed with sand you get a quicksand, over which it is unsafe to walk. With only a little water you get a plastic mass over which it is a pleasure to walk and out of which children can make forts and pies, etc.,"—

A. I will endorse that still (laughing).

X-Q. 228. "When the sand dries out, more air gets in between the grains, and walking becomes hard, though the sand is by no means dry from a chemical point of view. When the amount of oil around the ore particle is sufficiently small, the air gets in and makes a froth possible; with more oil you get a plastic mass; with still more you get the bulk oil process." Have I correctly read from your article?

A. You have.

X-Q. 229. Did that represent your views at that time?

A. In a sense, yes. It might be said more accurately to represent what Dr. Grosvenor told me the afternoon before the lecture.

X-Q. 230. Does it represent your views now?

A. It does not.

MR. WILLIAMS: That is all.

RE-DIRECT EXAMINATION.

BY MR. SCOTT:

R-Q. 231. Have you any comment to make, Professor Bancroft, on the passages from this article which were read to you, about ore flotation?

A. I think the simplest way of dealing with this article is to say that it represented my views at the time I wrote it; that all parts in it which are inconsistent with the testimony that I gave yesterday are wrong to the best of my knowledge and belief, and very likely certain other portions in it are also wrong. With those exceptions it represents my views today.

R-Q. 232. Can you describe any experimental proof of the existence of viscosity in the surface film?

A. That can be measured in different ways. If you suspend a needle by a fine string and let it go down into the mass of a liquid, and then cause it to swing by means of a magnet or in any other way, you will find that you get a definite rate of damping, as it is called, or slowing down of the swing of the needle. If you do that same thing in the surface of a solution where the surface tension is lower than that of the pure liquid, and where the surface film is sup p osed to have an increased viscosity, you find that the needle comes to rest very much more quickly, showing that there is a distinctly

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greater resistance to the swinging of the needle. That experiment can be modified in all sorts of ways, but it comes to much the same general thing. The existence of a film at the surface having a lower surface tension than the mass of the liquid can also be shown very easily, because if you produce suddenly a fresh surface from somewhere in the mass of the liquid, that would then give you, on a momentary reading, a surface tension corresponding approximately to that of the concentration in the bulk of the liquid; it won't do it absolutely because it would be changing right along; consequently you would expect to find, if you made a rapid measurement of the surface tension of a fresh surface, say of a saponin solution or a soap solution, that it will be higher than if you measured it on an old solution. I can give you some more data in regard to that if you wish it. These data are on page 56 of the same book to which reference has been made before, Freundlich's Kapillar Chemie. These are determinations at room temperature of a saponin solution; the value of the surface tension of a fresh surface is about 73, while the surface tension of water is about 75; it is nearly up to the value of pure water. The value of an older surface is 52; thus the difference between the surface tension of the mass of the liquid when measured as rapidly as you can, and the surface tension of the surface film is the difference between 73 and 52, showing, you see that there has been a concentration of the saponin in the surface film. There are other data here, but that one will do as an illustration.

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MR. SCOTT: That is all.

R-Q. 233. THE COURT: When did you commence lecturing on flotation?

A. In the autumn of 1912, and I have been carrying that out, a little under a lecture to a little over a lecture on flotation ever since then.

RE-CROSS-EXAMINATION.

BY MR. WILLIAMS:

RX-Q. 234. Just one part of your testimony here I don't quite understand. On page 1092 in describing a certain experiment you say that the materials that you used, you were told contained 1% mineral in one experiment, and in another experiment that it contained 65% mineral. Do you mean the metal or the metaliferous mineral?

A. I was told that in both cases the content was 1% mineral and 65% mineral. What it really was, I said I didn't know.

RX-Q. 235. Of course you know it is customary to state the values in the metal, as for instance 1% zinc sulphide, would be .66% zinc; and these values are customarily stated in the metal, and we have to add to that what the sulphur would add. You did not do that in this instance, did you?

A. I don't think that can be true. If that were true of the concentrates, the concentrates would be pure zinc sulphide. I don't know—the figure that was given to me in both cases was 1% mineral and 65% mineral.

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Whether it was that or whether it was anything else between 100 or one-tenth of 1% I have absolutely no knowledge. I didn't analyze them.

WITNESS EXCUSED.

MR. SCOTT: Mr. Williams has submitted to me a form of agreement that we are agreed upon as to the manner of presenting this testimony regarding mill operations. I will just read it as it is written, I think, and will let it go into the record:

"We are willing to enter into a stipulation with the defendant respecting the testimony of Mr. Dosenbach and other witnesses with respect to operations at the Butte & Superior plant to the following effect:

"We are to be furnished with a flow sheet of the defendant's mill with respect to any operation about which the witness is to testify.

"We are to be permitted to inspect the mill in order to see how the plant is operated, so as to ascertain the source of the important details from which determinations are to be made.

"We are to be shown whatever typical original reports of the different steps in the operations and of different characters and kinds of original reports and compilations thereof we demand.

"After which Mr. Dosenbach and other witnesses as to operations and results at the Butte & Superior mill may testify to compilations made up by the witness and from data from other sources than his own personal

knowledge, provided the defendant undertakes to furnish the original and best evidence as to anything so testified to by the witness that we demand, and if the defendant does not do so the testimony not thus justified shall be stricken from the record:

"Provided that either party may produce witnesses as to regular operations and results at other mills than that of the Butte & Superior without producing the original or best evidence if such witness has inspected the operations in question and the results and has knowledge of the details derived from inspection of the regular reports of others made at the time."

And we are mutually agreed to enter into that arrangement.

THE COURT: The record may show that.

MR. GARRISON: I only want to say, in connection with this stipulation, your honor, that has just been entered into, that we wish to advise counsel on the other side that if they propose producing Mr. Dosenbach or any other witness with respect to the Butte & Superior mill and its operations we shall require sufficient notice and opportunity to inspect the mill within a reasonable time before the testimony of the witness, so that they may not be surprised that we object if we had not been given that reasonable opportunity. I think it is proper to say that at this time.

MR. KREMER: In pursuance of the notice just given, we desire to state that we will produce Mr. Dosenbach as a witness and under the stipulation just entered into certain matters would be necessarily available to you, and you desire an inspection of the mill.

We now tender you that privilege, and if it would be satisfactory, and satisfactory to the court, you may make that inspection today, this afternoon.

MR. GARRISON: Oh, we could not possibly make it in so short a time as from the adjournment of court. We shall need a very much longer time than that.

THE COURT: I suppose they will allow you to go in any time.

MR. GARRISON: He said today.

MR. KREMER: Yes.

MR. GARRISON: But you see our men who are at all available will be here in court until something like four or five o'clock.

THE COURT: I don't suppose they will limit you to one day.

MR. GARRISON: He said today.

MR. KREMER: My statement carried with it the suggestion that they might take this afternoon if it would save time. I have no doubt your honor would be willing they should take it.

MR. GARRISON: We do not want to be limited to any brief time. When do you propose to produce Mr. Dosenbach?

MR. KREMER: Monday.

MR. GARRISON: Can we have the inspection on Sunday?

MR. KREMER: Yes, I think so. I do not want to say that they can have it and then have a part of the mill shut down.

MR. GARRISON: We can't possibly do it in two or three hours.

MR. KREMER: Have all day tomorrow.

THE COURT: Haven't you had an inspection?

MR. GARRISON: No, sir.

MR. KREMER: The mill will be running all day tomorrow.

MR. GARRISON: Then we may have the inspection tomorrow?

MR. KREMER: Any time you please. Will you designate who will make the inspection for you, and the time?

MR. GARRISON: I will give all of that after recess; I will fix it at lunch so as not to keep the court now, while we confer. Is that satisfactory?

THE COURT: Yes.

E. W. ENGELMANN, recalled on behalf of the defendants, having been previously sworn, testified as follows:

DIRECT EXAMINATION.

BY MR. SCOTT:

Q. 1. Mr. Engelmann, will you first state what records, and what is the extent of the information you have with you, so we will know before we start.

A. I have the result, the tonnages, the assays and the amount of oil used for every day since the beginning of operations in 1914.

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Q. 2. THE COURT: Has this witness been on the stand before?

THE WITNESS: Yes, sir.

Q. 3. THE COURT: What company are you from?

A. The Ray Consolidated Copper Company, Hayden, Arizona.

Q. 4. MR. SCOTT: I think you stated your employment and education when you were on the stand before, didn't you?

A. Yes, sir.

Q. 5. Now, you—if you were asked about the details of any particular day that occurred in these quarterly periods you can give that information, can you, as to the particular days?

A. Yes, sir.

Q. 6. Regarding the amount of oil or other factors?

A. I can.

Q. 7. What kind of material do you treat by flotation at the Ray Consolidated Copper Company?

A. We have two different products; one we call our retreating plant feed. It consists of a concentrate made on the vanner. The other is our slime vanner tailing, which is the tailing from the slime vanners.

Q. 8. About what tonnage do you treat per day?

A. We treat approximately 7,000 tons of slime vanner tailings per day and 350 tons of retreating plant feed—that is, by flotation.

Q. 9. Have you a summarized statement of the operations on these various concentrating products?

A. I have. Do you want it for months or quarters or years?

Q. 10. Quarters I think will do to start. Will you just read the title of the paper you are going to refer to, so we can identify it?

A. "Ray Consolidated Copper Company, Hayden plant, Flotation Operations Retreating Vanner Concentrate Products."

Q. 11. Now what period of time does that statement cover?

A. From the last quarter of 1914 until the first of April, 1917.

Q. 12. You were in charge of those operations throughout this period or were familiar with them?

A. I was in charge of the operations throughout the entire period.

Q. 13. The first column there of this tabulation sets forth the total tons treated by flotation in each of the periods mentioned, I take it, from the heading?

A. It does.

Q. 14. The second column is the assay of the copper in the heading. Now the No. 2 columns there, they are the tonnage and the copper assay of the flotation concentrates?

A. They are.

Q. 15. Now, under the heading "Flotation" you have "Copper Recovery." Will you explain the heading, the average of those two columns?

A. Under the "Copper Recovered" we have "Appar-

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ent" and "Estimated," but in this particular case we derive our flotation tonnage of concentration from our ratio of concentration which is derived from our assay. So consequently our apparent recovery and estimated recovery are both derived from the formula as given in one of the engineering journals that we adopt throughout all our plants and are practically the same.

Q. 16. Now, "New Oils Per Ton." The heading of the next column there: I take it that simply refers to the actual measured or weighed amount of oil that is fed into the pulp per ton of solids in the pulp?

A. Yes, sir.

Q. 17. Now, we come to the heading "Oil Assays." Will you explain that? "Flotation Heads, Including Circulating Loads"?

A. The column "Flotation Heads, Including Circulating Loads," represents the amount of new feed plus the circulation tonnage against the amount of new oil, plus the circulating oil. That actually represents the pounds or per cent of oil in the total feed. The next column, the "Concentrate Assay," represents the per cent of oils that go to our final installation in the concentrates; and the third column represents the per cent of oil that is in our tailings, going to waste.

Q. 18. How do you measure the circulation tonnage?

A. These circulation tonnages are measured at intervals of every hour in special tubs built for measurement. These tubs are 6 feet in diameter and approxi-

mately 5 feet high. We run the total feed into these tubs for a period of two or three minutes and take the per cent of solids at the same time we run the feed into the tub, thereby referring to the table, we have compiled, we get the tons of solids per day circulating.

Q. 19. You maintain a steady and uniform feed from day to day?

A. We do.

Q. 20. How are your circulating loads sampled and determined for oil analysis?

A. I can best explain that by reading our method.

Q. 21. Before, that possibly it would be better to explain the arrangement of the flotation plant. Have you any sketch that will serve for a flow sheet?

A. I have. I submitted one the last time for this plant, but I have another one here.

Q. 22. You gave one to counsel the other day?

A. No, I didn't get it. Here is one here, though.

Q. 23. What one are you going to use to put in evidence?

A. There is one in evidence already. (Exhibit No. 45.)

Q. 24. Now, I think you commented on this some the other day, but I think in order to get this clearly before us you might briefly refer to it again. Maybe if you put it on the desk the court could see it at the same time you are explaining it.

MR. WILLIAMS: I will lend your honor my copy.

A. The original feed goes into a small pump sump.

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and is pumped from there into the back of the first emulsifier. We have two emulsifiers in series. The discharge from the emulsifier is evenly distributed between five cells in multiple. These are Janney and mechanical flotation machines. And we make a finished concentrate on the five cells in multiple. The tailings from each individual cell in multiple join as one product and go to a series of five cells in series. The froth or middlings from these five cells in series goes back and joins our original feed, this getting to the head of the first emulsifier. The tailings from the last cell in series go to waste. The oil is added at the sump, where the original feed and circulating load go to the pump. Now we will come back to our question as to how the circulating loads are sampled and determined for oil analysis.

Q. 25. Will you make an indication on here as to the position?

A. Yes.

Q. 26. If you wish to, then we will have it all on the one exhibit.

A. "Method for Sampling and Determination of Oil in Pulp Used at Ray Consolidated Copper Company, Hayden Plant. Hayden, Arizona.

"Sampling. Samples are taken by hand in a metal sample cutter. The form and principle dimensions are as follows: The body of the cutter is cylindrical in shape approximately four inches in diameter and eight inches high. The cutter is held in hand by a loop handle similar to the usual tin cup handle. Opposite the

handle is placed a spout extending at the top nine inches from the bowl and tapering from this outer edge to the bottom of the bowl with parallel sides one inch apart.

"In sampling this cutter is moved across the stream of pulp at such a rate as the sampler knows by experience will furnish a sample containing approximately one hundred grams of solids. This sample is transferred to a white enamel pan and brought to the laboratory for test.

"Determination of oil: The samples are immediately filtered upon receipt in the laboratory. This is performed in a Buchner funnel with suction. The pulp still moist upon the filter is then treated with successive small portions of chloroform which almost completely removes the oil, the latter being caught in the filter flask in chloroform solution.

"The chloroform is displaced upon the filter contents with water and the pulp is removed to a low temperature drying oven (temperature 140° F) and dried over night.

"The chloroform solution of the oil is separated from the water in a separatory funnel and placed in a small weighed flask. The chloroform is then distilled from the flask through a deflegmation head and recovered.

"When the distillation of the chloroform is almost completed, the flask is removed and the evaporation of the remaining choloroform accomplished by very gently warming with a soft flow of air into the flask. After cooling, the flask and contents are weighed and weight of oil noted.

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"When dry the pulp is weighed and thoroughly mixed by rubbing in a glass mortar. Thirty grams are taken for extraction dry in a Soxhlet extractor and after extraction the oil recovered is weighed in small flasks, the chloroform being removed by evaporation as with the oil extracted wet.

"The weight of oil extracted dry is calculated to the equivalent for the whole sample and added to the amount previously recovered.

"The percentage of oil in dry pulp is then calculated from the total weight of oil and the weight of solids."

Q. 27. MR. WILLIAMS: Now, you have read that from a document which you had before you. Did you write that yourself or dictate that?

A. No, sir; that was dictated by Mr. Johnson, our oil expert.

MR. WILLIAMS: I suppose he knows more about that particular thing than you do, and you thought you would rather have his views?

A. Absolutely.

MR. SCOTT: If you object to it, I am not at all particular.

MR. WILLIAMS: No, I do not object.

THE COURT: What is this?

THE WITNESS: Analysis of oil determination.

MR. WILLIAMS: It is highly technical. I wanted it to appear that he was not testifying to it, but was reading what his oil expert said, to which I have no objection.

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Q. 28. THE COURT: This is the oil in the circulating load?

A. Yes, sir, and in the concentrates and in the tailings.

Q. 29. MR. SCOTT: And at what point are those samples taken for oil analysis, referring to this flow sheet? You might place a letter at each place you sample so that we will know.

A. "A" represents the tub where we measure our circulating load. "B" represents the point at which we take our sample for oil determination in our concentrates. "C" represents the point at which we take our determination for oil analysis in our tailings.

Q. 30. How do you measure the new oil that you add? I think you said at the pump sump.

A. It is added at the pump sump, but it is measured by a circular tank which has a reservoir, and we have a gauge glass graduated in eighths and quarters and halves and inches; and these are read at intervals of each hour, and the oil is fed with a mechanical feeder. These oils are checked against our total oil consumption for the month in our large storage tank out of the mill.

Q. 31. Will you state what quantities of oil you have used during the period flotation has been operated—I mean the range of quantities and when you changed from one quantity to another—that is, any marked change. I see up to the end of 1916 your quantities ran quite uniformly. Then beginning with 1917 they increased.

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A. Well, for the last quarter of 1914 to the end of the year 1916 our oil has only varied from 3.22 pounds per ton at the minimum to 5.28 pounds per ton maximum, for that period of time. After the year 1916, beginning January, 1917, we used 20.02 lbs. per ton, and in the month of February we used 18.77 lbs. per ton. From then to March we used 21.19 lbs. per ton.

Q. 32. Referring to the columns giving the assay of the concentrates and tailings and recovery, will you state in a general way how the results that you have obtained since January 1, 1917, compare with those prior thereto?

A. For the years and quarters previous to 1917 we have maintained a slightly better grade of concentrates than we did to the year 1917. Our tailing has been—Well, for the year 1914 we made a .617 tailing; for the year 1915 we made a .502; for the year 1916 we made a .375 and the year 1917, when using excess oil, we made a tail of .412. That is, including the month of March, Now, in the year 1914 we made a 92.94% extraction using 4.31 lbs. of oil per ton. The year 1915 we made 93.43% extraction using 4.21 lbs. of oil per ton; the year of 1916 we made 94.69% extraction using 3.36 lbs. of oil per ton, and for the first quarter or up to the first of April of 1917 we made 95.42% extraction with 20.1 lbs. of oil. Our extraction for the year 1917 has been the highest we have maintained since the beginning of operations.

Q. 33. How many pounds of copper per ton does the

difference between 94.69% recovery in 1916 and 95.42% recovery for the first quarter of 1917 represent?

A. Well, according to my figures I have saved for the year 1916, 105 lbs. of copper per ton, and during the year 1917 122 lbs. of copper per ton.

Q. 34. That is 17 lbs. more in 1917?

A. Seventeen pounds more.

Q. 35. Per ton?

A. Yes.

Q. 36. Now, I notice that in the first quarter of 1917 you treated 28,913 tons. That would be a saving of 17 lbs. of copper for each ton in 1917 as compared with 1916, on the basis of these two recoveries?

A. Yes, sir.

Q. 37. About how much additional expense is involved in this extra oil you are using; about how much does that cost additional?

A. Well, we changed our oil proportions. Previous to the year 1917 we were using—well, we were using 75% of Barrett's No. 4 and 25% of fuel oil. That was the general trend of operations during that year. And during the year 1917 we changed our oil to 90% fuel oil and 10% Barrett's No. 4. Now the Barrett's No. 4 is our expensive oil and our fuel oil is very cheap oil, but as far as the cost of oil per ton, I really have never figured it. Our fuel oil only costs us 3½ cents a gallon and our Barretts' No. 4 costs 36 cents a gallon, so we have used quite a large proportion of the fuel and cut

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down on the Barrett's, thereby cutting down our oil cost considerably—that is, the mixture.

Q. 38. What different kinds of machines have you used, and what were the tonnages when running with 20 lbs. of oil or over, during the first quarter of this year?

A. That is, you are speaking of the machines used in the retreating vanner concentrates?

Q. 39. Yes, confine it to that for the present.

A. We have only used the one machine on vanner concentrates and that is the straight Janney Mechanical Machine.

Q. 40. What kind of apparatus did you—do you use in treating the slime vanner tailings?

A. Well, we have three different kinds of machines. Our plant is composed principally of the Janney Mechanical Air Cell. It is similar to the mechanical machine only it has the air basket in the spitzkasten. Then we have what we call a straight air machine which is similar to the Inspiration type machine.

Q. 41. You may describe that briefly, the straight air machine.

A. I have—

Q. 42. (Interrupting.) I think the description will be enough without any drawing.

A. I have the drawing here if you want it. It is simply a long, rather narrow machine. The compartments are approximately three feet square and we have 16 cells in series.

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Q. 43. How is each cell made; what is its construction, how do you put the air in it?

A. Each cell has a filter medium at the bottom.

Q. 44. A porous bottom of some kind?

A. Yes. And the air is injected through this porous bottom and coming in contact with the pulp, and each cell has an overflow launder for the concentrates, and the tailings from one cell go to the next, right down through the 16 cells, until we have the final discharge at the last cell, and this total concentrate is considered one product, our rougher ~~regular~~ concentrate; it is recleaned in six cells of similar type, a recleaner. The tailings from this cleaner come back to the ninth or the middle part of the roughing machine.

Q. 45. Have you got the diagram of flow sheet of that?

A. I have, right here. These are separate platforms, numbered 1 to 16.

The feed comes in at the head of cell No. 1. From that cell we receive a concentrate and the tailings go to No. 2 and No. 3 and No. 4 and on until we get final discharge from cell No. 16, which is the tailings to waste. The concentrate passes from all these cells combined as one product and goes to our retreating machine, which is the same machine only six cells in series. The concentrate from the six cells in series or the retreating machine goes out as a finished product. The tailings come back to cell No. 9, or practically the middle of the roughing machine.

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Q. 46. Where is the oil added to the pulp in this air machine?

A. It is added with the pulp at the head of No. 1 cell.

Q. 47. And where are samples taken for oil, assay, etc.?

A. The sample for oil assay is taken—"A" would be right in the cleaner tailings, circulating back, and "B" would be the concentrate product from the cleaning machine. I think we have an assay on out tailings in that machine. Yes, I have one. "C" is the assay of the tailings which goes to waste.

Q. 48. Now, you have other machines in the slime production you said?

A. Yes.

MR. SCOTT: I think I will offer this in evidence, this being entitled "Ray Consolidated Copper Company, Air Machine Treating Slime Vanner Tailings".

The paper admitted in evidence and marked DEFENDANT'S EXHIBIT 149.

Q. 49. Now, if you will describe the other machine.

A. Our main installation treating plant treats 7000 tons of slime vanner tailings per day, the concentrate of the Janney Mechanical Air Machines. We have the flow sheet of that which is somewhat more difficult to follow than the previous flow sheet submitted.

Q. 50. You might produce that flow sheet, please.

(Witness produces the sheet.)

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Q. 51. What tonnage passes through that air machine you just described?

A. We treat from 300 to 415 tons, I think, per day.

Q. 52. Per day?

A. Yes, sir.

Q. 53. And this is by far the larger part of the slime plant?

A. This is practically the whole slime plant outside of the air machine. This set of machines treat practically 7000 tons of ore per day. We have two pyramids.

Q. 54. Just explain how you use that word "pyramid".

A. Well, it consists of one cell above the other, the original feed coming into the first row of cells, the tailing from that row of cells goes to the next row and the tailing from that to the next one, and the tailings from the last row, to waste. Just four machines in series, one above the other.

Q. 55. And that machine at the ridge, part of the tailings from that go each way, part goes down to the machine on one side and part to the machine on the other?

A. Yes, equally divided to both sides of the pyramid.

Q. 56. And what does each of these circles with an "X" in it, represent?

A. The machine, represents one row of machines.

Q. 57. The Janney agitating type machine?

A. Mechanical air machine.

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Q. 58. You have written on this drawing eight rows of cells. I take it that this drawing simply represents one row?

A. Yes.

Q. 59. Have you a photograph of it?

A. Yes, I have. There is the side.

Q. 60. Altogether how many of the Janney cells are there in this whole system?

A. There are 140 roughing cells and 45 cleaning cells.

Q. 61. Now, will you describe the flow of the pulp?

A. The feed and oil go to two emulsifiers.

Q. 62. Where are they?

A. They are at the head of the pyramids in multiple.

Q. 63. Represented by this machine, that box there?

A. No, no, they are in a pit, below the pyramid, and the discharge from the emulsifier goes to elevators which elevate the feed up to the first row of cells of the pyramid. Our original feed goes to the first row, and from there the tailings is distributed evenly to both sides; it goes to another row. The tailings from the second row go to the third row, and the tailings from the third row go to the fourth row, and the tailings from the fourth row go to waste. The concentrate produced by the first, second and third rows make up what we call the rougher concentrate. The concentrate from that fourth row circles back to the head of the elevators which feed the first row. The rougher concentrates go to two elevators and are lifted

P. 3543, L. 12, " the same percentage of water in the feed ; and " after " are "

primary cleaners go to one elevator and from there through 5 multiple cells followed by five multiple cells, followed by five more multiple cells, and the tailing from the first five go to the second five, and from the second five to the third five, and the tailings from the third five go back to the head of the primary cleaning system. The concentrate from the secondary cleaning machines go to filters as a finished product.

Q. 64. About how fine is this material that you speak of that is treated in the slime plant?

A. Approximately two per cent on a 65 mesh, and seventy per cent through a 280 mesh.

Q. 65. How about the material treated at the retreating vanner concentrate; about what is the screen analysis of that?

A. 6.12 per cent on a 65 mesh and 45.61 through a 280 mesh.

MR. SCOTT: I offer the first tabulation referred to by Mr. Engleman, the one entitled "retreating vanner concentrate products?

> Tabulation admitted in evidence without objection and marked DEFENDANT'S EXHIBIT No. 150.

Q. 66. Have you a tabulation of the operations of treating the slime vanner tailings by flotation?

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A. I have.

Q. 67. What period of time does this tabulation cover?

A. From the second quarter in 1915 to March 26th, inclusive, 1917.

Q. 68. I notice on this tabulation that beginning in the month of January, 1917, the amount of oil was increased. Will you just briefly compare the recoveries and assay of the concentrate before and after the increase in the amount of oil?

A. During the year 1915 we consumed 1.71 pounds of oil per ton. Our tailings assayed .572, which would indicate an extraction of 38.2. During the year 1916 our consumption of oil was .85 pounds per ton and the tailing assay was .419, indicating an extraction of 45.64. During January 17th and 18th, 1917, our coal tar consumption was 20.3 pounds per ton and our tailing assay was .465, with an indicated extraction of 43.56. During the month of February 8th to 28th, a period of 20 days, we consumed 20.1 pounds of oil per ton, maintaining a tailing of .375, with an indicated extraction of 45.25.

Q. 69. Now, what kind of machines were those operations conducted in for those two periods January 17th and 18th, and February 8th to 28th?

A. For the period of January 17th and 18th, we made the runs with our pyramid installation, that is, the machines treating our big flotation tonnage. The period between February 8th and 28th inclusive, we made the runs on the air machine which was described previously.

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Q. 70. What makes the difference between the grade of the concentrate on January 17th and 18th, as compared with February 8th to 28th?

A. On January 17th and 18th during the run our flow sheet was practically the same it is ordinarily, as we had two recleanings, a double system of cleaning; but for the period February 8th to 28th the air machine is so arranged that we get only one cleaning, and we maintain a concentrate equally as high as our normal grade of concentrate from the primary cleaner; that is to say, the normal operation in previous years from the primary cleaner concentrate was an average between eleven and a half and thirteen per cent.

Q. 71. Then all these entries after the first, during the year 1917 represent operations with one cleaning?

A. No.

Q. 72. Will you state just which ones represent one cleaning and which represent two cleanings?

A. Well, January 17th and 18th, there were two cleanings. February 8th to 28th there—that was only one cleaning. March 1st to 14th there was only one cleaning, and March 15th to 17th there were two cleanings; March 20th to 26th were two cleanings. Now the result: On January 17th and 18th and February 8th to 28th and March 1st to 14th the results were obtained with one oil, while the results from March 15th to 17th and March 20th to 26th were obtained with another oil. They were both mixtures, both of these oils, or was it a single oil?

A. March 17th and 18th, February 8th to 28th.

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March 1st to 14th were obtained with straight coal tar. For the other periods, March 15th to 17th were obtained with fuel oil principally, and a small amount of Barrett's, and the results from March 20th to 26th were obtained with flotco No. 20, and flotco No. 21. I have an explanation of the machines, how many cleanings and the product received at the bottom of the report.

MR. SCOTT: I offer this table entitled "Ray Consolidated Copper Company treating slimes vanner heading and slime vanner tailing."

Tabulation admitted in evidence and marked DEFENDANT'S EXHIBIT No. 151.

MR. SCOTT: I offer the flow sheet referred to by the witness, entitled, "Janney Mechanical Air Cells of Pyramid Installation Treating slime vanner tailings."

Tabulation admitted in evidence and marked DEFENDANT'S EXHIBIT No. 152.

MR. SCOTT: I offer in evidence a photograph of the pyramid machines referred to by the witness.

Photograph admitted and marked DEFENDANT'S EXHIBIT No. 153.

Q. 73. Will you describe any experiments you have performed with different amounts of oil and what the purpose of performing those experiments was?

A. We performed experiments using different amounts of oil both for the retreating plant feed and

our slime feed, and the purpose of those was to see if it was possible to maintain nearly the same results by using the different quantities of oil. On March 30th and 31st and April 1st, a period of three days, we treated by flotation in our retreating plant feed, using an oil mixture of ninety per cent fuel and ten per cent Barrett No. 4. We treated 1125 tons with 22.24 pounds of oil per ton, and made a concentrate of 21.48 per cent copper and a tailing of .32 per cent, with an indicated extraction of 96.14 per cent. During the period April 3rd, 4th and 5th, on our retreating machine, using the same oil mixture, 90% fuel and 10% Barrett No. 4, treating 1133 tons, we consumed 11.27 pounds of oil per ton and maintained 21.28 per cent copper concentrate and .290 per cent copper in the tailing, with a 96.67 per cent extraction. On March 30th, 31st and April 1st, treating our slime vanner tailing with straight coal tar, treating 795 tons, consuming 22.41 pounds of oil, we made a tailing of .375 per cent copper, an indicated extraction of 47.63. During the period April 3rd, 4th and 5th, while treating our slime vanner tailing, using straight coal tar, treating 772 tons of feed and consuming 11.2 pounds of oil per ton we maintained .366 per cent copper in tailings, with an indicated extraction of 46.15.

Q. 74. How do these results compare metallurgically with the larger and smaller quantities of oil?

A. Well, we maintain on our retreating machines month in and month out approximately 96 per cent extraction, which corresponds very closely with the ex-

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traction made on these runs. On our slime feed we maintain for months at a time between 40—42 and 46 per cent extraction.

Q. 75. When you say you maintain you refer to operations before the first of January, 1917?

A. Before the first of January, using small amounts of oil.

Q. 76. Yes.

A. Now, during these runs the operation was kept normal at all times; we simply increased the oil, and that is the only change in the operation that we made.

Q. 77. With reference to the statement you have just made, the figures you gave are from this table headed "Ray Consolidated Copper Company, comparative results obtained from air machines and retreating machine when consuming more than one per cent of oil per ton and also one half of one per cent of oil per ton, using the same mixture throughout." That is the table you refer to?

A. Yes.

Q. 78. Now, as to the results obtained on your table, there is a tabulation of the results obtained by eliminating fuel oil from the oil mixture; what was the purpose of that operation, eliminating the fuel oil?

A. I simply eliminated the fuel oil from the oil mixture to see whether we could maintain results. We tried at different times to run on straight fuel oil, but we could never maintain metallurgical results; so we eliminated the fuel oil and used the same out of Barrett No. 4—approximately the same amount that we

used in the mixure of both, and on April 7th on our retreating plant feed using straight Barrett No. 4 on 344 tons, consuming 2.39 pounds of Barrett No. 4, we made a tailing of 1.083, with an indicated extraction of 85.95. On April 8th, on the retreating plant feed using straight Barrett No. 4, treating 356 tons, consuming 1.31 pounds of oil, which corresponds to the amount of Barrett used when we consumed 11.27 pounds of mixture, we got a tailing of 1.25 with an indicated extraction of 82.89 per cent. Now, on April 7th the extraction through these figures represents a decrease of 10 to 14 per cent by eliminating the fuel oil. On April 7th while treating slime vanner tailings using straight Barrett No. 4, treating 245 tons, consuming 2.07 pounds of Barrett No. 4, we made a tailing of .456, an indicated extraction of 33.65. On April 8th, treating the slime vanner tailings, treating 273 tons, consuming 1.13 pounds of straight Barrett No. 4, we maintained a tailing of .543, or an indicated extraction of 25.39.

Q. 79. Those last two operations, on the 7th and 8th of April, compare with what other amounts?

A. Well, they don't compare with the results on March 30th or 31st and April 1st when we used large quantities of oil, because on those days we used straight coal tar. I then simply ran the straight Barrett on our slime feed to see if it was possible to maintain our percentage of extraction with straight Barrett. We found that it fell practically 15. per cent below.

MR. SCOTT: I offer in evidence the tabulation

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referred to by the witness, quoted "Comparative results obtained by air machines and retreating machines, etc."

> Tabulation admitted in evidence without objection and marked DEFENDANT'S EXHIBIT No. 154. (Two sheets).

Q. 80. Do you have any difficulty in getting the necessary oil for these flotation operations?

A. We have very little difficulty in getting the oil necessary for one per cent of oil in our feed on our retreating machine, but we have very great difficulty in getting enough of the oil that we use on our slime treatment; it has practically been to date impossible to get enough oil to continue operations daily with the use of more than twenty pounds of oil per ton on 7000 tons of feed.

Q. 81. You have described all of the machines in the plant, have you not, the air machines and the pyramid for the slimes and the other machines for the vanner concentrate?

A. The mechanical machine—we have another small machine there that we are treating a hundred tons per day with, using 20 pounds of oil to the ton, simply for experiment. It is called the K. K. machine.

Q. 822. What kind of a machine is that?

A. Well, it is a single unit within itself. I don"t know hardly how to describe it. It is a rotary with baffles on a shaft enclosed in a sort of cylindrical housing. The feed goes into one end with the oil, and this

rotary revolves approximately 180 revolutions a minute and it simply churns the feed and the oil and the air that it takes in at the intake, against the housing, and discharges it through round holes into a long spitzkasten, which is the length of the machine, and from this the concentrate is removed from the tailings and discharged at the opposite end of the machine from where it comes in. I have some cuts here of the machine, I have a drawing, but there is no flow sheet of this machine because it goes in at one end and out at the other, and the concentrates go out of the spitzkasten.

Q. 83. Those cuts that you have got, do they make its construction clear at all?

A. Well, not unless you really understand the machine. Here is the cut I have. I also have here a photograph of the machine in operation.

MR. SCOTT: We offer the photograph in evidence.

Photograph admitted in evidence and marked DEFENDANT'S EXHIBIT No. 155.

WHEREUPON an adjournment was taken until 2:00 P. M. Saturday, April 28th, 1917.

Q. 84. This morning I asked you to compare in amounts of copper that would be recovered, by the figures prior to January, 1917 and afterwards, more than 20 lbs. of oil was being used. Will you state whether that figure that you gave, 17 lbs. of copper, expresses any real facts regarding the comparative merits of the two operations and if not how you would compare them.

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A. Well, in figuring the pounds of copper saved by extraction it does not mean anything to mill operation. We figure pounds of copper saved and the advantage or disadvantage of the process, in the amount of copper going to waste in the tailings per ton of ore. And, in comparing the year 1916 with the year of 1917, the way we would compare it, on the pounds of copper going to waste in the tailings, you really must find the tonnage or the relative amount of tailings in comparison to the tons of ore treated, and I find on figuring by ratios of concentration, getting the tons of concentrate produced per ton of ore treated, and then getting the ton of tailings made per ton of ore treated. Taking your tonnage of tailings times your assay of your tailings, I find that when using for the year 1916, 3.36 lbs. of oil per ton we have practically the same amount of copper going to waste in our tailings as we had during the year 1917 when we were operating with 20.1 lbs. of ore per ton.

Q. 85. Referring to the tabulation of the treatment of the slime vanner tailings, state whether or not the operations, the daily operations from February 8th to 28th were regular and constant or not.

A. Well, our daily operations on slime feed is practically normal at all times. That is, each hour of the day is practically the same as the preceding and the succeeding hours. We have immense storage facilities. The capacity of our plant consists of Dorr thickener, then we get our feed to the vanner and then to

the flotation, is handled in such an immense quantity that there is, each hour during the day, they won't vary to any extent in feed. Now, during the period that you mentioned, the period from February 8th to 28th, when using 20 lbs. of oil or more in our slime feed, we treated on the 8th, starting out the operation, a very much smaller tonnage than the rest of the month would indicate. On this day we treated 180 tons. Then, for the succeeding days we averaged between 367, 336 and 378 tons per day, showing that our average was practically uniform, every day, every hour for every day in that month; and our oil consumed will average between 19.84 to 21.85 lbs. per ton for each day, showing that the average is practically normal at all times.

Q. 86. Now referring again to this tabulation of slime vanner tailings treatment, you say that the tonnage down to the end of 1916 is apparently greater than that after you began to use a large amount of oil. Now will you state why that is so?

A. In our slime treatment we found that we got best results when using crude coal tar and our tonnage was so great in this machine or on this product that we have been unable to date to secure a sufficient amount of coal tar to run our entire plant and so we just simply get enough oil to run at the times that we can, and we are endeavoring to collect as much of that coal tar as we can, and at the present time we have practically 100,000 gallons of coal tar which will throw the entire installation on a 1% or more of oil. In

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order to operate daily on our tonnage with 1% or more we would have to have approximately 14,000 gallons of coal tar a day or we would average about 140,000 lbs. or better than 3,000,000 lbs. per month. We have been unable, to date, to secure more than 50,000 gallons per month, so that we have to collect this oil and store it until we get enough to run five or six or possibly ten days on 1% or more. We have endeavored to get the coal tar from any source possible.

CROSS EXAMINATION,

BY MR. WILLIAMS:

X-Q. 87. What did you do in this slime vanner plant on the days between those that are given in 1917 in your table, exhibit 151?

A. We operated with our usual amount of oil, as we operated previously to this year.

X-Q. 88. That is you say the smaller—that is to say you used the smaller amounts of oil that you used before, in the days between when you have not got a large amount to use?

A. Yes.

X-Q. 89. And you have not made any showing of those operations in your table?

A. No, I have not indicated that for the year 1917.

X-Q. 90. You have described a pyramid plant, or a set of machines arranged in pyramid, a set of air

machines, and represented them in a separate drawing I suppose they are separate plants, are they?

A. They are separate plants.

X-Q. 91. In none of these proceedings which you report here were they run together, is that right?

A. Yes they are arranged so they can be run together or run separately.

X-Q. 92. Did you ever run them together?

A. We did.

X-Q. 93. Do any operations appear in the reports where they were operated together?

A. The operations of January 17th and 18th, the operations of March 15th to 17th, and of March 20th to 26th.

X-Q. 94. Have you described the manner in which they were connected up; possibly I have not followed you when you testified?

A. I have in this note below here, where I say that we recleaned twice; it simply means that we operated the pyramid as a roughing machine, and then recleaned by the air machine, which gives us a double recleaning.

X-Q. 95. Now, when you use the air machines alone, what was the condition of the feed to the plant? You have noted here feed, and you have noted oils as going into the same place. Had there been any preliminary mixing of the ore and the oil?

A. There had not.

X-Q. 96. So that in this instance you used this

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long series of air machines to perform the operation of mixing as well as aeration, is that right?

A. Well, I will correct that statement to this effect. We did for a while send our feed and oil through the same emulsifier and then we sent our feed separately, and only our oil and water through this emulsifier, and the two combined just as they entered the machine.

X-Q. 97. So that in that instance you had a pre-emulsification of the oil?

A. Yes.

X-Q. 98. But it was pre-emulsified out of contact with the ore?

A. Yes.

X-Q. 99. Did you maintain that as a standard operation?

A. Well, not during the entire. We would switch from one to the other.

X-Q. 100. There were times when there was no pre-emulsification of the oils, and without any pre-mixing or emulsification of the ore and oils you fed the ~~and~~ oils separately and the ore separately into the air machine, is that right?

A. There were times when we did both.

X-Q. 101. In the operation with smaller quantities of oil did you ever use the air machine alone?

A. You are speaking of the slime vanner tailings, are you?

X-Q. 102. I understood that it was part of the slime plant?

A. It is.

X-Q. 103. Yes. If you ever used it in any way, just tell me; tell me what you know and then I will know what you know.

X-Q. 104. Yes. You mean when we treated the slime vanner tailings in the air machine with small quantities of oil?

X-Q. 105. Yes.

A. We did.

X-Q. 106. In what manner was the oil and ore fed as to emulsification?

A. The ore and oil were emulsified before entering the machine.

X-Q. 107. Emulsified together?

A. Yes.

X-Q. 108. Can you tell me when you commenced to use this air machine?

A. I don't know whether I have the date on that or not. It was in the latter part of 1916. The result I have here showing the result of the air machine on small quantities of oil is of January 10th, 1917.

X-Q. 109. That is the first entry that you have?

A. As a roughing machine, no; we used it in the latter part of 1916 as part of our cleaning system of our entire installation; I don't know just what date we put it in, but it was in the latter part of the year 1916 that we put it in.

X-Q. 110. Did you put it in in the last month, in December?

A. Yes, I think it was in December.

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X-Q. 111. I notice in your table "Flotation Operations treating slime vanner heading and slime vanner tailings," that the first period given is the second quarter of 1915, with the smaller tonnage than any succeeding quarter. That was the commencement of the operation of this plant?

A. Yes.

X-Q. 112. And as the plant was then installed at the commencement of operation, in what respect did it differ from the plant that you have described?

A. At the commencement of operations the plant was a straight mechanical machine.

X-Q. 113. Janney?

A. Yes. We did not have the pyramid installation then; it was five mechanical cells followed by five mechanical cells arranged in multiple. There was a feed going to each cell separately from the others, and the tailings combining and going to five cells separately. There were two lines of machines, five in each, in multiple, a straight mechanical machine. Then later on we installed the air basket.

X-Q. 114. You had in this first plant your first set of machines and roughers, and your second set of machine cleaners?

P. 3265, L. 27, insert " roughers, and then followed by another set of five as " after " as "

were arranged in multiple.

X-Q. 115. What did you do then with the middlings from the cleaner machines?

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A. They circulated back to the head of the roughers.

X-Q. 116. Give me the data for some one day's operations in that first quarter of 1915?

(Witness produces book.)

X-Q. 117. Now, let us take June 15, 1915, please read off to me your record for that day, taking the numbers with the head of the column so that the number will be understandable.

A. 631 tons of heading, 549 tons of tailing, 15 tons of concentrate, 951 lbs. of No. 4 oil, 21 lbs. of pine oil; total 972 lbs. of oil.

X-Q. 118. And what was No. 4 oil?

A. That is the Barrett's No. 4 creosote.

X-Q. 119. Now, you might give me the average for the month of June or the smallest period that you have operated upon the amount of oil used per ton of ore treated.

A. Well, I will give you the average for the month of June, 1.91 lbs. of oil for the month of June, 1915.

X-Q. 120. Now let us turn to July, 1915. Were the oils used the same during July as during June or was there a change?

A. There was a partial change. I find that we used during the month of July some California fuel oil.

X-Q. 121. In addition?

A. To Barrett's No. 4 and the pine oil.

X-Q. 122. Now, read off the descriptive entries for July 15, 1915.

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A. Treated 1121 tons; 1081 tons tailings and 40 tons of concentrates; 1468 lbs. of No. 4 oil; 41 lbs. of pine oil; total 1509 lbs. of oil.

X-Q. 123. Have you the assay of the heads, concentrates and tails of that day?

A. I have.

X-Q. 124. Read them.

A. Headings, 1.13%.

X-Q. 125. Copper?

A. Copper. 81.13% insoluble, 2.05% iron; tailings .535% copper; concentrates 17.3% copper; 31.33% insoluble; 10.9% iron.

X-Q. 126. Now will you give me the similar assay for that day, June 15, 1915?

A. Heading 1.4% copper; 84.73% insoluble; 2.7% iron; .473% copper tailings; concentrates, 26.53% copper; 29.87% insoluble; 10.27% iron.

X-Q. 127. Now, give me the average per ton of ore in the month of July, in this plant, 1915.

A. 2.01.

X-Q. 128. Now, let us turn to the beginning of 1916. In January of 1916 had there been any change in the oil used?

A. I will have to look and see. In January, 1916, we were using Lewis tar acid and Jones oil.

X-Q. 129. What is Lewis tar acid?

A. It is a creosote, coal tar creosote with, if I am not mistaken—This was a 30% tar acid content in the creosote.

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X-Q. 130. And the Jones oil, is there any other name for that?

A. I have never heard it. It has the appearance of a crude oil.

X-Q. 131. And these were the only two oils used during the month of January, 1916?

A. They were.

X-Q. 132. Now, let us take the 15th of January, 1916, read off the record for that day.

A. 2261 tons treated in the head; 2226 tons tailings, 25 tons of concentrates; 2470 lbs. of Lewis tar acid; 823 lbs. Jones oil; 3293 total lbs.; 1.45 lbs. of oil per ton of material treated.

X-Q. 133. Now, let us have the assays of that day.

A. .75% copper in heading; 91.80% insoluble, 1.6% iron; .506% copper in the tailings; 22.96% copper in concentrate; 24.93% insoluble in concentrate and 8% iron in concentrate.

X-Q. 134. Now, I would like a typical individual day in among these operations during the present year

P. 3268, L. 24, insert "Take the run of February 8th to 28 in this same plant" after "ton"

of concentrates, 7560 lbs. of coal tar, 20 lbs. of oil per ton of ore.

X-Q. 135. That is very close, isn't it?

A. Some here go below and some above.

X-Q. 136. Now, we will have the assay.

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A. .710% copper in headings, .393% copper in tailings; 13.06% copper in concentrates; 63.06% insoluble in the concentrates; 6.03% iron in concentrates.

X-Q. 137. Now, we will take the record for February 11, 1917.

A. Treated, 463 tons headings; 456 tons tailings, 7 tons of concentrates; 85.68 lbs. of coal tar, 18.50 lbs. per ton of material treated.

X-Q. 138. Now the assay.

A. .680% copper in headings; .455% copper in tailings; 14.46% copper in concentrates; 50.20% insoluble; 7.20% iron.

X-Q. 139. Before I leave this particular plant, what did you do with the material, what did you do with the kind and grade of material that you treated in this plant before you installed it?

A. This material was treated on our big permanent installation.

X-Q. 140. Of what kind of concentration?

A. Flotation concentration.

X-Q. 141. No; before you had flotation.

A. This material was going to waste.

X-Q. 142. Not, in the other plant, for retreating the vanner concentrate products; is that right?

A. Yes, sir. This statement is wrong. We shipped this product to smelter.

X-Q. 143. Your fourth quarter—Your table shows the fourth quarter of 1914 as the first entry. Will you let me have a daily record during that fourth quarter? Take the record of November 15, 1914.

A. Treated, 207 tons of heading; 163 tons of tailings; 44 tons of concentrates; 624 lbs. of creosote, 212 lbs. of California fuel oil.

X-Q. 144. And the total pounds of oil per ton of ore is then given for the day?

A. Yes, sir. 836 lbs. of total oil; used 4.34 lbs. of oil per ton of material treated.

X-Q. 145. Now, the assays.

A. 7.23% copper in the heading; 73.80% insoluble; 7.13% iron; .563% copper in tailings; 4% iron in tailings; 31.87% copper in concentrates; 22.53% insoluble in concentrates; 16.93% iron in concentrates.

X-Q. 146. Now, let us go to the first quarter of 1916 in that plant. Give me the figures for January 15th, 1916.

A. 250 tons heading, 201 tons tailing, 49 tons of concentrate, 487 lbs. of Lewis tar acid, 161 lbs. Jones oil, 40 lbs. Chesapeake pine, total 689 lbs. of oil; 2.76 lbs. of oil per ton.

X-Q. 147. What is Chesapeake pine; pine oil or pine tar?

A. Pine oil.

X-Q. 148. Now, the assay.

A. 5.4% copper in headings; 73.6% insoluble; 6.9% iron; .40% copper in tailings; 26.1% copper in concentrates; 60.9% insoluble; 21.2% iron.

X-Q. 149. Now, let us look at some of the operations in 1917 with larger quantities of oil. Were these operations continuous from their commencement?

A. Yes, sir.

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X-Q. 150. Give me the record for January 8th, 1917.

A. Treated, 300 tons headings, 240 tons tailings, 60 tons concentrates, 5432 lbs. California fuel oil; 603 lbs. Barrett No. 4 creosote; total 6035 lbs. of oil, or 20.11 lbs. of oil per ton.

X-Q. 151. Now, the assays?

A. 5.3 per cent copper in heading, 77.4 per cent insoluble, 6.2 per cent iron. 4.96 per cent copper in tailings, 24.50 per cent copper in concentrate, 28.3 soluble in concentrat~~ion~~e and 18.16 per cent iron.

X-Q. 152. Now give me the record for January 9th, 1917?

A. Treated 300 tons; 238 tons tailings, 62 tons concentrate; 5342 pounds of California fuel oil, 297 pounds pine oil, 297 pounds Barrett No. 4; total oil 5936 or 19.78 pounds of oil to the ton of material treated.

X-Q. 153. Now, the assays?

A. 5.7 copper in the heading, 76% insoluble, 6.2 per cent iron. .583 per cent copper in the tailings, 25.2 per cent copper in the concentrate, 29.23 per cent insoluble, 17.13 per cent iron.

X-Q. 154. Now, let me look at the report for February, 1917. Give me the report of February 24th, 1917?

A. 300 tons of heading, 204 tons of tailing, 96 tons concentrate. 4471 pounds California fuel oil, 497 pounds Barrett No. 4, total 4968 pounds of oil, or 16.56 pounds of oil per ton.

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X-Q. 155. Now, the assays?

A. 8 per cent copper in the heading, 71 per cent insoluble, 8.2 per cent iron. .380 per cent copper in the tailing, 24.26 per cent copper in the concentrate, 27.36 insoluble, 19.2 per cent iron.

X-Q. 156. In these figures that you have given me of the assays, has there been an inclusion of an copper oxide?

A. Yes.

X-Q. 157. In the tailings?

A. Yes.

X-Q. 158. And did your tables show the amount of oxide, or was that separately assayed.

A. The assay indicated in the table takes into account the amount of oxide in the product.

X-Q. 159. Does it include it or exclude it?

A. The assay includes the oxide.

X-Q. 160. So that the tailing is actually composed of so much metallic copper and so much oxidized copper, and they are both counted together in the assay?

A. Yes.

X-Q. 161. How large a factor would that be in the operations, the amount of oxidized copper that goes in the tailings?

A. Well, it is greater than fifty per cent of the copper in the tailings; for instance, if you have four tenths of one per cent copper in the tailings, .28 will be in the form of oxide and .12 in the form of sulphide.

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X-Q. 162. And that is a fairly uniform average is it?

A. Yes.

X-Q. 163. My attention is called to the fact that I said metallic copper when I should have said copper sulphide. You understood me to mean copper sulphide?

A. **Yes, that was just a mistake.**

X-Q. 164. Now, in your operations have you used anything else than oil, ore and water?

A. That is, any other chemicals?

X-Q. 165. Yes.

A. We have not?

X-Q. 166. Or acid?

A. No acid.

X-Q. 167. And no other reagent?

A. The only thing that is in the ore is, they add lime at the mine, simply to protect their screens and rolls at the head of the mill, but that is not done for any flotation purpose, because we can get very much better results without the lime than with the lime.

X-Q. 168. That is, the ore as it is dug out of the ground is a little acid?

A. Yes.

X-Q. 169. You put in lime to neutralize that?

A. Yes.

X-Q. 170. And is that true of your operations since the first of the year as well as before?

A. Well, we ran into the acid ore about the middle of 1916, about the middle of the year, and it has been continuous ever since.

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X-Q. 171. The acid?

A. Yes.

X-Q. 172. That is sulphuric acid of course?

A. Yes.

X-Q. 173. Do you ever heat your pulps?

A. No, sir; we have never tried heat.

X-Q. 174. Now, I wish you would describe for the court what an operator does when he is controlling the operations of a flotation plant? Let us go back to the time when you used the small amount of oil. Of course you understand just how it is done, and I would like you to tell what the operator does, what is it that controls him in his regulation of the plant?

A. He pays very close attention to the amount of oil he is adding. He can tell by the appearance of his machine whether he is adding a sufficient amount of oil to maintain good results.

X-Q. 175. By the appearance of the froth in the machine?

A. By the appearance of the froth in the machine and the way the machine is acting. He inspects his elevators every so often, to be sure that there is no slippage and that the feed is coming to the plant steadily, and tries to maintain normal operating conditions at all times. He will go over his machine and determine whether he has sufficient air to produce a concentrate whereby on the recleaner he will maintain the grade that we would like to have maintained in our plant, and any irregularities that happen in

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the plant, why he is so trained that he knows exactly what to do and where to go in order to counterbalance this fluctuation of operation.

X-Q. 176. I suppose the appearance of the froth is one of the important indications when anything needs attention, is it not?

A. The appearance of the froth, as well as the discharge of the froth.

X-Q. 177. That is the amount?

A. The amount.

X-Q. 178. The amount of the overflow?

A. Yes.

X-Q. 179. In these machines of yours do you have a natural overflow or do you help it along with a paddle?

A. No, in these machines we have no mechanical froth removers at all.

X-Q. 180. The froth just overflows by gravity?

A. Yes, in this slime treatment. In treating the concentrate we have mechanical removers. The froth is much heavier and more compact, but we don't have the mechanical removers on the series cells of the cleaning machine. We have at the multiple machines where we make the finished concentrate, but the slime treatment we have no mechanical removers.

X-Q. 181. What are the conditions in the appearance of the plant by which the operators are told to reduce the oil supply?

A. In operating, if the appearance of the froth is

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sort of—our slime is yellow slime, and if the appearance of the froth is too yellow, he comes to the conclusion that he is discharging more insoluble or a lower grade of froth than he really should, and you can either cut down or diminish the air to a certain extent, or you can cut down your oil, and when the operation is normal or practically so, you can maintain about the same results at that point. Cut down your agitation or cut down your oil.

X-Q. 182. Can you give me separately the oxides and the sulphide copper assays of the heads and tails for the year 1916?

A. I think I can.

X-Q. 183. Will you do that?

A. Yes, sir. I cannot give you the heads; I can give you the tailings. On treating slimes, the per cent of oxidized copper in the tailings will average for the year 1916 .20. On retreating the concentrate, the oxidized copper in the tailing for the year 1916 will average .18.

X-Q. 184. Now, have you got it for the first quarter of the year 1917?

A. I can give it to you by the month.

X-Q. 185. All right, give it for each month separately.

A. For the month of January, 1917, the percentage of oxidized copper in the slime tailing was .276, and for January, 1917, the percentage oxidized copper in the tailings for retreating concentrate was .214. For the month of February, 1917, percent oxidized copper

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in the heads for February, 1917, on our slimes was .311; percentage of oxidized copper in tails for slimes during month of February was .266; percentage oxidized copper in concentrates, retreating concentrates, was .19.

X-Q. 186. Now, these figures in the slimes plant have been both the operations with amounts of ore exceeding 20 lbs. and operations with amounts of oil less than 20 lbs. per ton of ore, have they not?

A. Yes. This statement is made up of the total slimes treated regardless of the amount of oil used.

X-Q. 187. Now, what arrangement does your company have for the selling of concentrates?

A. We have a flat rate with the smelter. If I am not mistaken, it is $5.00 per ton of concentrates regardless of per cent. of copper, insoluble or iron; we are not penalized for insoluble and we are not penalized for iron.

X-Q. 188. And where are your concentrates smelted?

A. In the town of Hayden, about a quarter of a mile from the concentrator.

X-Q. 189. What is the name of the smelter?

A. It is the American Smelting & Refining Company.

X-Q. 190. Now, in regard to your contract, isn't that affected by the price of copper?

A. No, I think not. We have a flat rate of so much per ton of concentrate.

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X-Q. 191. Do you know that as a fact, or is it just a matter of information?

A. No, I don't know that as a fact. I haven't seen the contract, but that is my understanding.

MR. WILLIAMS: We have still of course to have the operations such as have occurred since the first of the year connected up with the prior art, and with that reservation for the completion of that testimony, I close the cross examination at the present time.

RE-DIRECT EXAMINATION

BY MR. SCOTT:

R-Q. 192. What is that $5.00 you mention; is that a smelting charge?

A. That is a smelting charge per ton of concentrate, that they charged the Ray Consolidated Copper Company.

R-Q. 193. How about the amount of attention and adjustment the flotation apparatus requires when, say 20 lbs. or more of oil are being used per ton as compared with when using three or four pounds?

A. They make no cha~~r~~nge in the operation at all.

R-Q. 194. I meant the amount of attention it requires from the attendant.

A. It requires no more attention to operate with 21 pounds than it does to operate with three-quarters of a pound.

R-Q. 195. I think you found a cut of that K & K machine this noon?

A. Yes, sir, I have a cut of the machine.

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R-Q. 196. I wish you would briefly explain the operation of that machine and put any letters on you need to, to tell what these two pictures are you have.

A. "A" will represent the intake for feed and oil. "B" represents tailings to waste. "C" represents concentrates discharged. "D" represents the shaft on which this baffle spindle is connected which revolves at the rate of 180 revolutions per minute. "E" will represent automatic operating float discharge. "F" will represent housing surrounding the rotator which is composed of baffles.

R-Q. 197. Can you explain the operation better from the cross section?

A. On the cross section view "A" will represent the rotator which is built up of baffles. The feed comes into the machine at one end and the centrifugal force of this rotary, which is 180 r.p.m., draws the feed and the oil and discharges it against the inside of this housing.

R-Q. 198. Where is the pulp in the machine before it is picked up by the rotary?

A. Well, it comes right in at one end of the rotary. The rotary is entirely the machine.

R-Q. 199. Just make a mark to show where this pulp is thrown.

A. The pulp would hit in right by the letter "B".

R-Q. 200. Now, place a letter where the pulp is picked up by that rotary.

A. The pulp is picked up at the letter "C".

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R-Q. 201. And then it is whirled around in this upright space between the rotary and the housing?

A. Yes, sir.

R-Q. 202. Then put a letter where it is discharged.

A. Discharged at letter "D".

R-Q. 203. Where does the air come from that makes the bubbles for the froth?

A. The air comes—goes in with the feed at the intake and also at the end, with the shaft, supported by the bearings. The air goes in at both places. There is suction on both ends of the machine and suction at the intake of the machine; three places where the air can enter the machine.

R-Q. 204. Are these placed apart, these what you call baffles, or slats, whatever they are?

A. Yes, about a quarter of an inch apart.

R-Q. 205. Do I understand that the air is drawn out through there, and this narrow sheet of pulp?

A. No, you understand the air is taken in at the ends and entered into the machine at the same point that the feed enters, and this inside of this rotary, there is chance for the feed to get inside of there, too, through these places where the bearing is.

R-Q. 206. You said the pulp progressed through the machine; what is its movement, its course?

A. It would progress similar to a curve.

R-Q. 207. You mean it goes around through the rotary more than once?

A. In starting the machine without any oil at all, and putting your oil in, the froth will first form at the

head, and then it will work slowly down to the tailings.

R-Q. 208. MR. WILLIAMS: You have this rotating device as a long cylinder extending the length of the machine and rotating at the speed you have stated? Is that right?

A. Yes, sir.

R-Q. 209. This cylinder has an outer surface composed of what you call baffles which appear to be supported by slats; is that right?

A. Yes.

R-Q. 210. Now, outside of these baffles there seem to be some similar contrivances; what are they?

A. Those are baffles.

R-Q. 211. Those are real baffles?

A. Those are real baffles. This is just the timber to attach the baffles to.

R-Q. 212. So that these baffles are practically a series of slats extending over the outside of this rotating cylinder?

A. Similar to the riffles on a Wilfley Table.

R-Q. 213. And what is the over-all length of the machine, about?

A. It is 14 feet long and about 4 feet high.

R-Q. 214. And about what is the diameter of that rotating cylinder inside?

A. As close as I can estimate it is about two feet; probably a little larger.

R-Q. 215. No, if it is four feet high, if the machine is four feet high—

A. (Interrupting) 32 inches they have there, to be

exact. It is 32 inches—that of course takes in the base and the housing.

R-Q. 216. The over-all height of the machine is given here as 32 inches. It can be readily computed.

A. I don't know what the exact dimensions are, but that housing is only about an inch and a half timbers.

R-Q. 217. The inside of the housing is smooth?

Yes, sir.

R-Q. 218. And it is a complete water tight housing?

A. Yes, sir.

X-Q. 219. I don't remember just what you said about the use of this machine. Is it—what is it used now in your plant for?

A. We are using that machine to test different kinds of oils now, and we did use it as a test on some small quantity of oil, and with large quantity of oil, just a comparative test of the two.

R-Q. 220. And you found it worked pretty well with either?

A. Equally as good with the large percentage of oil as it does with the small percentage.

MR. SCOTT: I offer this illustration, one of them on the large sheet entitled "K & K Flotation Machine" the other the small folder entitled "K & K Flotation Machine Bulletin No. 1".

The documents were admitted in evidence and marked DEFENDANT'S EXHIBITS 156 and 157.

(WITNESS EXCUSED.)

BEN H. DOSENBACH, recalled for further direct examination by Mr. Scott having been previously sworn testified as follows:

DIRECT EXAMINATION,

BY MR. SCOTT:

Q. 1. You are familiar, are you, with the Everson patent?

A. I am.

Q. 2. Have you ever attempted to carry out the process described therein?

A. I have.

Q. 3. What apparatus have you used for carrying out this process described in the Everson patent?

A. One form of apparatus that I have used is an apparatus that is built according to the Fryer Hill publication.

Q. 4. That publication that is in evidence?

A. That publication that is in evidence in this case.

Q. 5. Have you the machine here?

A. I have.

Q. 6. Will you refer to the Fryer Hill publication and compare the description therein contained with the machine itself?

A. With reference to the Fryer Hill publication, the "Daily Herald Democrat," Leadville, October 30th, 1889. This is a publication which refers to a certain method of concentrating ores with the use of oil.

and in that description a machine or apparatus is described. This publication states that "The whole system of concentration appears to be based on the well known affinity of the lighter forms of sulphuret and chloride of silver for oils. Petroleum is the oil now being used by the parties having these experiments in charge and appears, from its density, to possess the requisite adhesiveness to effect the results desired." It says that "The ore is first crushed and rolled to such a degree of fineness as to enable it to pass through a 40 mesh screen and while dry, is thoroughly mixed with the oil, after which it is placed in a circular tank or receiver."

Q. 7. What are you reading, Mr. Dosenbach; the Fryer Hill publication?

A. Yes.

Q. 8. Unless you have some comment to make on some part of it it won't be necessary to read it.

A. Well, I was just coming to the description of the machine in this publication and I will follow it up by referring to the machine itself, which I have now in court and also to a drawing which represents the machine. The ore is thoroughly mixed with the oil "after which it is placed in a circular tank or receiver." This is the circular tank or receiver that will be used in the experiment which is illustrated in this drawing by the circular tank or receiver.

MR. WILLIAMS: I just want to call attention to the fact that the witness said "The ore is thorough-

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ly mixed with oil" omitting two lines of the description, one part of which says that the ore is crushed so as to pass through a 40 mesh screen.

THE WITNESS: I have read, that, Mr. Williams, begging your pardon.

MR. SCOTT: If you wish to, you can point out on the machine as you read it.

A. "Through the center of which runs a rotating hollow tube," which is this rotating hollow tube in the drawing and this rotating hollow tube on the machine itself. "To the bottom of which tube is attached, on two opposite sides, a couple of fans," which are these fans at the bottom of the hollow rotating tube as shown in the picture, these two rotating fans,—"the lower edges of which are unevenly cut in order to send—in the revolutions—the lighter particles of the ore and oil mixture to the outer sides of the drum or cylinder." That is th~~is~~ese lower edges of the fans which are unevenly cut, so as to give an upward motion to the agitated material, which is shown on the machine itself, are unevenly cut, the lower edges of the fan. "This rotating hollow tube is perforated at, or near, the bottom," which shows several small perforations at or near the bottom, just small holes, just above the fans. "and, when the receiver is thoroughly charged, acidulated (sulphuric acid is used). Steam is introduced through the tube and is forced to the bottom of the mixture while the arrastralike fans, attached to the bottom of the tube, keep the whole mixture in

motion, and, the action of the revolving tube, the fan, and injected acidulated steam causes the lighter portions of the mineral-charged oil to float to a point just above the center of the receiver, where there are suspended two semi-circular doors, when the oil has passed above them, laden with its precious freight, are raised, and the superfluous water allowed to drain through slight perforations in the bottom of these semi-circular doors, after which the mineral-laden oil is carefully removed to settling barrels revolving with jets of steam injected continuously from the lower end." Well, the rest of that we needn't show, because that is an after treatment to recover the metal. These doors, however, are perforated, as shown in the machine itself, and also in the drawing which I have here. This shows the shaft and the semi-circular doors raised, and this shows them when they are lowered after agitation. The mineral froth rises to the surface above the doors and the doors are closed, and as the description says, "in order to recover the metal."

Q. 9. Now, will you state what ore you are going to use and how you are going to proceed in carrying out the experiment or demonstration.

A. In the experiment that I am about to perform according to the Everson patent and also the Fryer Hill publication, I will use Utah Copper ore, or the retreatment classifier overflow from the Utah Copper Plant.

Q. 10. What quantity of oil are you going to use?

A. I will use 300 gms. of this ore and to it I will

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add 51 gms. of a petroleum distillate. After adding the 51 gms. of petroleum distillate I will thoroughly mix the dry ore and the oil, making a homogeneous mass of the oil and ore. This will then be placed into the receiver of the machine, and I will then add 1250 c.c. of water. The machine will then be started, and as I cannot use any steam or acidulated steam, I will use hot water containing sulphuric acid, to correspond to the acidulated steam which is mentioned in the Fryer Hill publication. The agitation will be continued for possibly two or three minutes. I will perform the experiment, and after having performed the experiment, will give a complete description of the operation.

(Whereupon a short recess was taken.)

(Test No. 30.)

THE WITNESS: Now, if you would like to have a sample of that ore that we are going to use in the experiment, you can have it.

MR. WILLIAMS: Very well, we will take it.

Q. 11. You might state, while we are waiting, whether or not you are going to use the forty mesh material described in the Fryer Hill publication?

A. I am going to use material that is through a forty mesh screen, yes, sir.

Q. 12. You are metallurgist enough to know that what you have said may have several meanings. Is this forty mesh?

A. It will all pass a forty mesh. There will be approximately two or three per cent of it on a sixty-five mesh, which is slightly finer than a forty mesh screen, and ranging from there on up to the finest size, which is minus 280 mesh.

Q. 13. That is to say this is a product containing a great amount of slime?

A. It is a product which contains about 60% minus 200 I should say. As I remember—and I will refer to the publication—the publication states the ore is first crushed and rolled to such a degree of fineness as to enable it to pass through a forty mesh screen.

Q. 14. THE COURT: Well, are you ready for this experiment?

A. Yes, sir. They have been sampling the ore, so as to give the other side half of the same material that I am going to use, and that has consumed considerable time.

I will now add oil, 51 gms., to the dry ore, and thoroughly mix the oil and the ore until a homogenous mass of oil and ore is formed.

Q. 15. THE COURT: You have what weight of oil and ore there?

A. I have 51 gms. of oil to 300 gms. of ore, which makes 17 per cent of oil relative to ore.

Q. 16. MR. SCOTT: Where do you get that proportion of oil to ore; what is it based on?

A. That is taken from the Everson patent, the figures as used in the Everson patent being reduced to the proportions that I now use. The oil and ore

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is now thoroughly mixed. I will now add 1250 c.c. of water, having a temperature of 42° C. I have now added 2.4 c.c. of sulphuric acid to 50 cubic centimeters of hot water, which I will add after starting the machine. (Machine started.)

Q. 17. MR. WILLIAMS: At what speed is that arrastra revolving?

A. I don't know what you mean by arrastra?

Q. 18. Well, the agitator that you have there, how fast does that revolve?

A. I will tell you in just a minute; I have it marked so I can tell when the machine stops.

(Machine stopped.)

Q. 19. MR. SCOTT: How would you describe that float as to its structure and what it is made up of?

A. I would describe that float to be a mineral froth consisting of copper sulphide mineral, air bubbles, which can be seen very distinctly by observing from the top, and naturally there is present around those air bubbles some oil. That froth I take to be something over an inch thick; about an inch and a quarter in places, and an inch in places, or an average of about an inch and an eighth. The differentiation from the tailings is a very noticeable difference, showing that there has been quite a concentration.

Q. 20. Will you compare this operation which you have just performed with the course of proceeding in actual concentration in a mill?

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A. It is very similar to the actual procedure in a mill, with the exception that in a mill there are a number of these same operations carried on in series, whereby the tailings resulting from this one particular operation would be retreated in another vessel of the same character as this one. There may be a great number of them, anywhere from 5 to 14, or possibly more or less, and this constitutes a part of the operation.

Q. 21. The first step, as it were?

A. The first step I should say. The tailing is settling very rapidly now, showing comparatively clear water between the tailings at the bottom of the solution or the vessel and the froth upon the surface.

Q. 22. In actual operation is it customary to make a final tailing with one operation of this kind?

A. It is not. They continue the operation and recover additional froth and mineral in a froth from the tailing that we now see in the bottom of the cylinder.

Q. 23. Is there any way in which you can get a sample of that concentrate there for analysis?

A. Why, yes, I can get a sample of the concentrate for analysis, showing the degree of concentration, that is, the amount of valuable mineral that is contained in the froth as compared to the original ore with which I started.

Q. 24. In that particular apparatus is there any way of getting all of that froth off, so you could determine the total amount of mineral that is in it?

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A. There is no possible way of recovering all of the froth in this apparatus, as the apparatus itself is merely to show the purpose that it was built for, and not for metallurgical recoveries; but a sample of the froth can be obtained and analyzed to show the extent of the concentration.

Q. 25. Will you do that now?

A. I can do that, or I can have it done and go ahead.

Q. 26. Well, it might save time if you have some one ~~froth~~ from each side do that?

A. That would simplify matters to have a representative from the other side assist one of the men from this side, and mutually agree as to the sample of the concentrate.

Q. 27. MR. WILLIAMS: Those doors which acted as baffles in that agitating operation, what use are you going to make of them now?

A. I will spread the doors out, as stated in the publication, and recover as much of the concentrate as possible, so that analysis can be made of the product, and I will do that myself so that it can be seen just how they work. Now, I have closed the doors, as it were.

Q. 28. MR. SCOTT: Raised them to a horizonal position.

A. Raised them to a horizontal position.

Q. 29. And they are down here below the froth as the court can see; they were hanging vertical, and you have opened them out?

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A. Yes. Now, the jar will be lowered, and the concentrate froth will rest upon the doors.

Q. 30. Instead of raising the doors in this machine, you simply lower the jar?

A. Yes.

Q. 31. MR. WILLIAMS: You did not give me the speed yet at which it turned?

A. Yes, I will give you that speed. It was between 1400 and 1500 revolutions per minute. Now, if one of the representatives from the other side is present and can assist in the operation we might go ahead, or watch the procedure.

Q. 32. MR. SCOTT: I would like the court to see how you get that off; it will only take a minute. You might state how efficient that method of getting that froth is?

A. It is a very inefficient and crude method of recovering the froth, but it shows the nature of it.

Q. 33. Where is the jar; you cannot get it all?

A. No, I cannot possibly recover all of it.

A. Now, I would like to state further that it can be readily seen that when lowering the jar and recovering the metal upon the cylindrical doors, that some of the mineral has fallen down to the bottom of the vessel and rests down in the tailings. There is quite a noticeable difference between the mineral which has fallen and the gangue material which are at the bottom, the mineral being very dark in color, lying in a stratum above the tailings; the tailings being very much

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lighter in color than the original ore, and decidedly so, as compared to the mineral in the froth.

Q. 34. Was there any dark mineral on top of the tailings, in the bottom, before you performed your operation with the doors?

A. There was not, and that was my reason for wishing to show it at this time.

Q. 35. Now, the other day Dr. Sadtler testified regarding the cataract machine described and illustrated in a German book which he produced. Have you had a machine made in accordance with that description?

A. I have.

Q. 36. Have you the machine here?

A. I have and I will bring it forth. If you will pardon me, I would like to state definitely what I used in that experiment, so that it may be upon the record In the experiment that I have just completed, following the Everson process in the Fryer Hill machine I used 300 grams of Utah Copper retreatment classifier overflow containing approximately 7.9% copper, 5.36% iron and 77% insoluble. To this ore I added 51 grams of a petroleum distillate and thoroughly mixed the two until a homogenous mass was formed. This oiled ore was placed into the cylinder of the machine and 1250 c.c. of water added at a temperature of 40° C.; the machine was then started up and 2.4 c.c. of sulphuric acid and 50 c.c. of hot water was added and the agitation continued for a period of 2½ minutes. Upon stopping agitation a mineral froth formed above

the semi-circular doors, being about 1 1/8 inches in thickness. After allowing the gangue material or tailings to settle to the bottom of the cylinder so that the solution was comparatively clear between the froth and the gangue I opened the semi-circular doors so as to spread them out horizontally and then lowered the cylinder, leaving a portion of the mineral froth resting upon these doors. The mineral froth that remained on the doors was then removed from the doors and the contents will be reported later.

Q. 37. I hand you the book that Dr. Sadtler referred to by Louis Andres and ask you if that is the illustration following which you had the machine constructed.

A. This is the illustration from which the machine that I will now present has been constructed.

Q. 38. Did you read it or have someone translate the descriptive part of the book for you?

A. Dr. Sadtler has translated the descriptive part of this book. It is in German and I am not very good at that.

Q. 39. Will you produce the machine?

(Witness produces the machine.)

MR. SCOTT: I might state for the information of the court that this publication following which that machine was built has been referred to by witnesses as describing an operation under the Everson patent and this is how we followed that. Now, this apparatus which Mr. Dosenbach has now was built after this

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publication, which was some years before the date of the Everson patent, the purpose merely being to use an apparatus that was known at that time.

MR. WILLIAMS: And this apparatus was an oil purifier, oil purifying machine, so described, was it not?

MR. SCOTT: If you want to testify you may do so, or have me.

MR. WILLIAMS: Well, if your honor please, I object to wasting the time of the court by carrying on experiments in an oil purifying machine for the purpose of showing an operation of ore concentration; as wholly incompetent, irrelevant and immaterial.

THE COURT: What is the purpose of this?

MR. SCOTT: The Everson patent described the agitation, the thorough agitation of the mass, and this agitator is simply taken from the technical literature.

THE COURT: You simply want to show that there were appliances that would agitate?

MR. SCOTT: And by performing this operation that would bring about the type of agitation suitable for the purpose of the patented process.

THE COURT: There is no question at all that at that time the world was full of agitating apparatus; every farmer's kitchen and yard had them, as far as that goes.

MR. SCOTT: The point was very strenuously made in the other trials that the record showed no agitating apparatus that was capable of accomplish-

ing the purpose, and great stress was made of it in the argument. I thought myself it was rather a far fetched point; and, being made and advanced seriously why we considered that we must meet it.

THE COURT: Well, how many more like it have you?

MR. SCOTT: Well, we will illustrate the Kirby patent.

THE COURT: No, I mean of these appliances that you want to show that were capable of agitation?

MR. SCOTT: This is the only one.

THE COURT: Let the record show what it is and the objection will be overruled. I believe the doctor already testified that this was an oil purifying machine.

MR. SCOTT: Yes, it is in the book; that is in the record and it has been referred to as an agitation apparatus. I think that is the point they laid emphasis upon.

Q. 40. Now, Mr. Dosenbach, have you found it possible to carry the Everson procedure on this apparatus?

A. I have found it possible to carry out the Everson procedure in the apparatus as set forth in that book described by Dr. Sadtler.

Q. 41. This is the same apparatus regarding which Dr. Sadtler's remarks appear on page 740?

A. It is the same apparatus as testified to by Dr. Sadtler.

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Q. 42. That built under your direction?

A. This was built under my direction.

Q. 43. And in proportion and form does it conform to the description in the German book you referred to?

A. It does with the exception that I had this glass cylinder put on here so as to see the result and the froth, and the proportions are very similar. There are baffles as stated—as shown in this illustration which are also in the machine and can be noted. This is a cross section and the baffles run around the whole circumference, inside directly above these two fans or arms which are shown in the bottom of the illustration. Directly above the baffles and on the shaft is shown another—a disk, which is this—I am pointing out now, and I take it from the illustration that the disk revolves with the shaft.

Q. 44. Now, will you state about what ore and the proportion you are going to use in illustrating the Everson process on this cataract apparatus?

A. I will use a material that is very similar to the one that I used in illustrating the previous Everson experiment. It is a Utah copper ore or a material called Utah copper retreatment classifier overflow.

Q. 45. That is what the other was?

A. That is what the other was. It is similar material.

Q. 46. Now, if you will proceed?

(Witness performed experiment No. 31.)

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A. I now have thoroughly mixed the ore and the oil.

Q. 47. How does the froth which you have formed in this cataract machine compare with the one which you made in the Fryer Hill machine?

A. They appear very similar in character. The froth formed in this machine is highly mineralized, consisting of copper sulphide, mineral and air bubbles. They seem to be very much the same in richness. However, the froth is a little thicker, it appears to be so, in this experiment as compared to the previous experiment in the Fryer Hill publication.

Q. 48. Was there more mineral in this or the other one?

A. There possibly might be. The amounts are very close.

Q. 49. What was the assay of the material used in the Fryer Hill machine?

A. An assay of the material treated in the Fryer Hill machine was 7.9 per cent copper, and in this machine I have it to be 6.18 per cent copper. There was a little more iron in the ore that I used in this experiment than in the one that I used in the previous experiment. The iron in the ore as used in this experiment was 6.69 per cent as against 5.36 per cent in the Fryer Hill experiment.

Q. 50. When you said this froth was thicker you meant it was of greater depth?

A. Greater volume and height.

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Q. 51. You didn't mean the consistency of the froth?

A. Absolutely not, because it will be readily seen the individual bubbles that are shown on the sides and also on the surface.

Q. 52. Did you give all the details of this experiment?

A. I have not given all the details but I will do so. During the process of the operation I took the speed, and it will be necessary to count this ratio before I can give it. The speed of agitation was 724 revolutions per minute.

Q. 53. And how long was it agitated?

A. Two minutes and a half. I will give the proportions as used in the experiment.

In the experiment just completed, following out the Everson patent in the so-called cataract machine I used 200 gms. of Utah copper retreatment classifier overflow, containing about 6.18 per cent copper, 6.69 per cent iron and 76.2 per cent insoluble. I added to this 200 grammes of ore, 34 gms. of Texas petroleum distillate, and thoroughly mixed the two to form a homogeneous mass. Having placed this oiled ore in the machine, I added 1250 c.c. of water at a temperature of 30° C. I next started the machine, and directly after starting the agitator I added 50 c.c. of hot water containing 1.6 c.c. of concentrated sulphuric acid. The agitation was continued for two minutes and a half at about 720 revolutions per minute. The

result upon stopping the agitator was that a very highly mineralized froth appeared on the surface of the pulp.

Q. 54. Are you going to remove a sample of that froth resulting in this experiment?

A. I think it would be advisable to remove a sample of the forth and furnish a duplicate sample to complainants.

Q. 55. Have you the material here this afternoon to perform a demonstration illustrating the California Journal of Technology article? If not, we will put it off?

A. I haven't it down here, no.

Q. 56. Well, we will go on with something that is here.

Q. 57. THE COURT: Let the court understand —these two experiments represent the Everson process?

MR. SCOTT: The specific quantity of oil and the amount of—and the kind of the oil.

Q. 58. Now, could you this afternoon demonstrate the Kirby process with 25% of oil?

A. I can.

Q. 59. Suppose you do that, then? Describe what you are going to do, if you wish to first?

A. I would suggest that a representative of the other side here assist in removing some of the froth that appears in the cataract machine.

I will perform an experiment using 25% of kerosene distillate, which is a thin distillate hydro-carbon,

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on some of the same material—a sample of the same material that I have used in the two Everson experiments. In the experiment that I am about to perform, illustrating the Kirby patent, I will use 300 gms. of Utah copper retreatment classifier overflow, the assay of which is about 6.15 per cent copper, 6.6 iron, and 76.2 per cent insoluble. I will use 1500 c.c. of water at a temperature of about 25° C., and 2 c.c. of concentrated sulphuric acid. The oil which I will use is kerosene or petroleum distillate, and I will use 92 c.c. of this oil, which is equivalent to 75 gms. or 25 per cent of oil relative to ore.

Q. 60. MR. WILLIAMS: Where is the Kirby machine?

A. I am performing the demonstration in the agitating glass jar machine.

MR. WILLIAMS: I object to that, and call your honor's attention to the fact that the Kirby patent shows a complete and elaborate apparatus capable of reproduction, and of which we have made a reproduction, and of course you can only understand what a patentee means by doing the thing as he did it. Now, this is an attempt to repeat the operation which takes place in that complicated machine, in a square glass jar, just as it was done in the Supreme Court of the United States and in Wilmington, Delaware, by these plaintiffs, and it seems to me that it is a waste of the time of the court to repeat in a glass jar, with terrific agitation, an operation which obviously could

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not have taken place under such conditions, and that the only operation that will be in the slightest degree relevant and material to this case will be an operation carried on in the Kirby machine. I will ask your honor to look at this machine, consisting of two vessels, an agitator and a separator, with all the details shown in the drawings.

In the next drawing is shown the separator, and there are still further drawings; a carefully devised apparatus, and here we have a glass jar with a rotating stirrer.

THE COURT: Well, now, I am a little doubtful of the value of some of these experiments myself, but, circumstances, of course, will be taken into consideration by the court in weighing the evidence. For instance, now, in the last two experiments which you say illustrate the Everson process, where do you get that agitation in the Everson process?

MR. SCOTT: The Everson patent says the mixture is thoroughly agitated. Now, the patent in suit has no stronger language than that on the subject of agitation.

THE COURT: Well, we will allow it to proceed for the purpose of the record. The objection will be overruled, and, as the court said, the circumstances, of course, will be considered. Really what you will do now, you might as well say, would be the process of the patent in suit with 25% of oil, wouldn't it?

MR. SCOTT: Absolutely; that is exactly what it is. The Kirby patent recommends that quantity of oil,

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and has really stronger language on the subject of agitation than the patent in suit. A process patent, as the Kirby patent is, is merely required to illustrate some apparatus capable of carrying out the process; the process is in no way related to the apparatus. This can be done in anything, a glass jar or with an egg beater, or any apparatus. So why build a complicated structure like Kirby had when the object is simply to show that agitation will produce the result.

THE COURT: Objection overruled.

Plaintiff excepted.

(Test No. 32)

THE WITNESS: I am now adding the acid after having added the ore and the water in the glass jar. I will next add 92 c.c. of distillate.

(Machine started and run for some time)

Q. 61. What result have you in this experiment, Mr. Dosenbach?

A. A very copious, highly mineralized froth is formed.

Q. 62. Are there any more details as to that experiment, or did you say everything you wanted to before you started it?

A. I gave the quantities used, and so forth, before starting the experiment. The only thing that remains is the agitation, which was for a period of three minutes at approximately 1600 revolutions per minute.

Q. 63. Have you prepared an experiment in which you make a froth and sinking granules with the same amount of oil?

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A. Yes, but I haven't time to complete the experiment this evening as it takes ten to twelve minutes to continue the experiment alone, much less get it ready.

Q. 64. You might describe it; it won't take but a little time to describe it and use the time up, so that we will get it in the record?

A. Yes, I can do that. I have performed an experiment and can repeat the same, using the cone Gabbett—

MR. SCOTT: I would like the record to show that samples of the froth in this last experiment as well as in the others, have been furnished to representatives of the plaintiff.

THE WITNESS: (Continuing) The experiment that I am speaking of was performed in the cone Gabbett machine on Butte & Superior ore using oleic acid and in one instance I obtained a froth and by reducing the agitation, the mineral sinks, and by again increasing the agitation the mineral will again float.

Q. 65. You mean all in the same mixture, by alternately agitating differently?

A. By alternate procedures, first obtaining a froth and then sinking the mineral and then obtaining the froth again, and I presume the operation could be continued alternately in the same manner for an indefinite length of time. However, I have not tried it more than several times each. The percentage of oil was upwards of one per cent—one per cent plus relatively to the ore. I think I used one and one half per cent of oleic acid relative to the ore used and the agi-

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tation was constant for from five to ten minutes for each proceedure.

Q. 66. Now, as the representatives of the plaintiff are going to visit the Butte & Superior mill tomorrow I think it would be a good idea if you take this time now and make a little sketch, flow sheet, and explain it to them. There will be time enough to do that?

A. Yes, I will get my flow sheet here.

Q. 67. You can do it on the board if you wish to?

A. Well, I can do that although I have prepared, several days ago, a large flow sheet, and you can observe any points on it just as well as looking at a diagram upon the blackboard.

Q. 68. Have you sent for it?

A. Yes, it will be here in just a moment. This flow sheet represents the flow of the material and the machines used in the flotation plant at the Butte & Superior Mining Company. It shows a plan view of the various machines that are used and there are eight in number, all identical, alike.

Q. 69. What does each one of these units show, the circle and a triangle at the end of it?

A. I may start in this way; this is one machine which we call a pyramid machine, which consists of seven cells. Each one of these agitating cells that I am pointing out here in the center has two spitzkastens, one on each side of it. There is a double row ~~a~~ of spitzkastens and a single row of agitators to each primary machine. There are eight of these primary machines

in the flotation plan that treat the same material. The material as it comes to the flotation plant and goes to this machine is practically all alike, and there is a distributor that divides it into eight equal portions. Here we have a cleaner and a recleaner machine which takes the product from the roughing machine and retreats the concentrate for the purpose of obtaining a purer grade. Now, I may follow this way, the flow of this in a general manner, and if there are any questions I can stop and answer them as I go along. For the purpose of illustrating and not to confuse with a great number of lines on each one of these pyramid machines, as they are all alike, I have selected one of them and on it I show the various products that are made and where they go.

MR. GARRISON: What number have you selected?

A. I have selected No. 7, and it shows by the red lines where the products go. That will not confuse the other machines, and the products from the other machines, joins along with No. 7 so we can consider the whole plant, when we speak of No. 7 pyramid. The original material coming to the flotation plant, which is the tailing from the concentrating or wet separation part of the mill is indicated by the words "slime and tube mill product." That material comes from the concentrating department and goes to two 36 inch elevators, No. 1 and 2, where it is elevated to a junction box indicated by numerical three. The junction box has an under-flow and an over-flow. The under-flow goes

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to an 8-way distributor from which it is distributed to these eight pyramid machines that I have just described. The over-flow goes to what we call the sludge tank, which is just an aleviating tank to take the variation in the feed that is discharged from the elevators. The underflow from the sludge tank flows to the elevator again and is a closed circuit so the sludge tank takes care of any excess of material that may come at any one given time. Now, before being distributed to the 8 pyramid machines, the feed is sampled by an automatic sampler, designated on this flow sheet by the numerical five. After being distributed we follow down to No. 7 primary, and if it was retreated in No. 8 it would be the same for each one of them. The material enters No. 1 cell. And as I said before each primary machine is a unit in itself and consists of seven cells. These seven cells are attached in series and the feed enters the first at this point, travels from the spitzkasten here into the next one and so forth down until it reaches No. 7 and through No. 7. That is the general flow of the material through the machine. Each one of the cells has two spitzkastens, one on either side of the agitating cells, where concentrates and middlings are taken off. The first three produce a rougher concentrate where—which is Nos. 1, 2 and 3. The next four, Nos. 4, 5, 6 and 7 produce a middling, which middling goes back again to these 36 inch elevators before mentioned and to the original feed, coming back again to the machine. The rougher concentrate that is made in cells Nos. 1, 2 and 3 go to a 16 inch elevator

where it is elevated to a small aleviating tank, No. 19, which is only a feed tank supplying material to the five cleaners which are all in pairs—have been in pairs, but are now as one machine—and as we follow the rougher concentrate it enters at this point and travels through these five machines or five cells to be washed, the same making a cleaner concentrate and a cleaner tail. Now, that cleaner tailing is no more than a middling product, the same as the concentrate recovered on the last four cells of the rougher machines and it goes back again to be retreated together with the original feed that is coming at all times, and that is a continuous operation. Now, the cleaner concentrate that is made upon this cleaner unit is elevated again to this tank 20, and goes to the recleaner where a final concentrate is made. The recleaner tailing goes to the rougher concentrate elevator and the recleaner cells where it is in a closed circuit, it being a little higher grade than the cleaner tailing. Then the tailing resulting from the No. 7 cell of the rougher machine goes to air cells of the pneumatic type, there being 14 in number. However, I have not shown the 14 as I wished to reserve this space, but there are 14 of them —where a final tailing is made from these air cells which goes to the tailings pond and to waste. The concentrate or middling product which is produced by these air cells goes back again through the system as a middling and is retreated with the original ore that enters the machine or enters the plant from the concentrating department of the mill.

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Q. 70. MR. WILLIAMS: What is the arrangement of these air cells? Are they all in series?

A. They are all in parallel.

Q. 71. All in parallel?

A. Yes.

Q. 72. So that the tailings go through—

A. (Interrupting) 14 of them.

Q. 73. 14 of them?

A. Yes, sir, in parallel.

Q. 74. One after the other?

A. Not if they are in parallel, no.

Q. 75. In parallel the tails would be divided into fourteen different lots, each going through one machine? Is that right?

A. Yes, sir.

Q. 76. That is what I supposed, but I wanted to make it clear?

A. Yes.

Q. 77. Where do you put your oil in? I suppose you use oil, a little?

A. Yes, I think we do, a little. We put the oil in before it comes to the elevator. We have put the oil in at the junction box and also the sludge tank. We are provided to put oil in at these places, but right now we are adding the oil to the feed as it comes to the flotation plant from the water concentrating department.

Q. 78. MR. GARRISON: Can you indicate on there the place where you feed the oil?

A. (Witness indicates on drawing).

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Q. 79. MR. GARRISON: How have you indicated it?

A. By putting a circle and "oil feed" on there.

Q. 80. Have you any copies of this drawing?

A. I haven't any copies of this particular drawing but I will endeavor to furnish copies for tomorrow, a number of them, so that your representatives will be as familiar as they would be if they had this one.

WHEREUPON an adjournment was taken until Monday, April 30th, 1917, 10:00 A. M.

10 o'clock A. M. April 30, 1917.

MR. GARRISON: If your honor please, two weeks ago yesterday we served upon defendants a notice to produce various papers, and in response thereto, after producing some papers, they stated that they would be unable to definitely respond to the balance of the notice until they had had further opportunity to make search, with which your honor concurred, very properly. It has now been two weeks that they have had this opportunity, and I desire to renew the call, particularly with respect to the vouchers, checks or other evidences of payment of moneys by the defendant corporation to James M. Hyde.

MR. KREMER: If there is anything of the sort found we will produce it.

THE COURT: Are you able to answer now?

MR. KREMER: I can not answer now because I have not paid any particular attention to the inquiry, outside of my first inquiry. I will ascertain at the noon hour if they have found anything. If they have, they will be glad to produce it.

MR. GARRISON: The suggestion was that they had to communicate with New York, and they have had time to do that.

MR. KREMER: If we have found anything we will produce it. I don't know whether they have got anything from New York or not. I have not inquired since the first day.

THE COURT: Are you ready to proceed this morning?

MR. Kenyon ~~KREMER~~: If your honor please, we noticed a motion in this case, for leave to file an amended and supplemental bill. I don't know whether there will be any objection to it.

MR. KREMER: Yes. We desire to object to the filing of the proffered supplemental and amended bill for the reason that said supplemental bill is not a supplemental bill within the contemplation of law or the process of this court, in that it sets forth only the matters which were known to the complainant and plaintiff during practically the entire pendency of this suit. For the further reason that no proper or sufficient or any showing has been made which would justify the filing of the supplemental or amended bill. The paper proferred is accompanied by a notice that the complaint ant will, on April 30th, move the court for leave to file a so-called supplemental and amended bill

of complaint, a copy of which is attached to the notice. There is no other showing made to the court. We object for the further reason that the so-called paper or document is conjunctive, in this, that it purports to be a supplemental, as well as a amended bill, and no showing is made to the court, by petition or otherwise, which would justify the filing of the bill as drafted. For the further reason that the bill, upon its face, discloses the fact that under the law governing the filing of supplemental pleadings, and particularly supplemental bills, and under the decisions of the courts regulating the filing of the same, this supplemental bill is improper for the reason that it sets forth only matters which were disclosed, by the very nature of the allegations, to have been known to the complainant at all times during the pendency of this suit, and the application for leave to file the supplemental bill is not timely and was not made until this case had proceeded a number of days, although at all times the complainants, according to their own allegations, were advised of the conditions therein contained. That is shown by their own allegations and the allegations in the prior pleadings in this case.

For the further reason that the attitude of the complainant in now applying to file this supplemental bill is not one of equity, in that they came into this court and proceeded to introduce their testimony and concluded their case, plaintiff holding itself out as the owner of this patent and entitled to proceed with this lawsuit, with a view to obtaining such benefits as it might obtain through the lawsuit, withholding

from the defendant all of the information now contaned in this supplemental bill, and no application was made or notice given to file a supplemental bill until after the defendant had placed upon the stand Mr. John Ballott, whose testimony disclosed that it was known to them at all times, the fact that this plaintiff was not the real party in the case.

We further object for the reason that in order to file a supplemental bill it must be apparent that the application is made timely and that the matters and things set forth in the supplemental bill are of such a character that they develop during the pendency of the suit and were acted upon with expedition and with diligence when they were disclosed. And it further appears that by the exercise of due and reasonable diligence facts, or alleged facts, set forth in the supplemental bill should have been presented to this court long before the time of their application.

We further object to the filing, if I might segregate it—I don't know how I can when the paper is labeled one and the same thing. A conjunctive appellation of supplemental and amended bills—but referring to that portion of the bill that sets forth what is purported to be amendment to and in substitution of paragraph 8 of the bill of complaint, the defendant objects to the alleged amendment for the reason that it is not timely; for the reason that all of the contentions therein contained were objected to by the defendant herein at the time of the attempted introduction of proof and a ruling was made that the complaint was broad enough to admit the character of testimony to which the objection

was directed. That being so, it is not timely now to propose this amendment, and particularly is the amendment not to be allowed for the reason of the long delay and lack of diligence in filing the same, and for the further reason that the said amendment, under its very allegation, is not sufficient in law, and by reason of this fact it is apparent it should not be permitted to be filed in view of the fact that no showing accompanied it and it is contrary to the decisions of the Supreme Court of the United States involving a like matter of law.

We submit the motion. Has your honor looked—I don't know as it is just fair to submit it. I think I should advise the court.

THE COURT: I certainly should know what is brought into the case or attempted to be brought into the case by this new bill.

MR. KREMER: If your honor please, by this supplemental bill, first, as I have stated in the objection, there has been no showing made to this court. My understanding of the practice is a showing must be made to the court for leave to file a supplemental bill; there must be something affirmative before the court, and there is nothing before the court, not a mere paper to which is attached a notice. I think upon that question of practice we all have an understanding of what is necessary. I don't know that all that is necessary is to present a paper. I think you must make a showing to the court, your reasons for desiring to file the supplemental bill. Now, I understand the further fact—I wish you gentlemen would correct me if I misstate this, because I am not quite as familiar as you are with it.

MR. KENYON: We will be glad to do so.

MR. KREMER: I think I can state it from the allegations. The supplemental bill alleges that the plaintiff, Minerals Separation Limited, entered into a contract or agreement of American rights, using the term broadly, of this patent on the 10th day of October, 1910, when there was granted to the Minerals Separation American Syndicate, Limited, the plaintiff herein, certain rights under said patent for a term of years. These rights were renewed by a written instrument from time to time up to 1916. Now, although it is shown to have been known that the Minerals Separation American Syndicate, had certain rights, they were not made parties plaintiff to this suit. We had no information, that is the defendant. And later it is alleged—

MR. KENYON: You want me to correct you if you have made a misstatement of the facts?

THE COURT: You better let them take that and they can present their side of the motion.

MR. KREMER: All right, I would be very glad to have them state it.

THE COURT: You have completed your objection, Mr. Kremer?

MR. KREMER: Yes, I have completed my objection.

THE COURT: Let them proceed with their motion.

MR. KENYON: The objects of the amended and supplemental bills are several. I will take them up in order. First, it is decreed the mandate of the Su-

preme Court in the Hyde case, the disclaimer that followed in consequence and the final decree that was entered in the Hyde case. Attached to this supplemental bill of complaint is a full copy of the mandate, with its date; of the disclaimer with its date; and of this final decree with its date, these documents showing that these various things occurred and they are proper matters for supplemental bill, not under the ordinary and accepted practice, but under the very rules of this court itself, where in rule 24, under "Supplemental Proceedings" it is stated: "Upon application of either party the court or judge may, upon reasonable notice and such terms as are just, permit him to file and serve a supplemental proceeding, alleging material facts occurring after his former pleading." Under this branch of it, this branch of our supplemental bills comes in.

Another branch of the supplemental pleading is what our motion and bill substantially amounts to, a plea to intervene by Minerals Separation North American corporation, to acquire title on December 7th, 1916, such title as the Minerals Separation North American corporation, acquired on December 7th, 1916. This supplemental traces back to its origin along in 1913. Giving the original document of July—some day in July, 1913, when Minerals Separation, Limited, one of the plaintiffs and Minerals Separation, American Syndicate, 1913, an intervening British corporation, together agreed, the one to sell and the other to purchase the beneficiary interest in the American patents, including the patent in suit, upon the happening of certain conditions and the making of certain pay-

ments. Our supplemental bill alleges that these conditions were finally perfected, and these payments were finally made in October, I believe it was, October 6th, 1916, at which time, last October, became invested in this intervening American Syndicate, the beneficial interest of these patents, legal title to which still remained in the Minerals Separation, Limited. And, as I say, on December 7th, this new corporation that now asks to be admitted as a party plaintiff, Minerals Separation North American Corporation, ac~~re~~quired the entire right, title and interest of this intervening American Syndicate of 1913 in this patent for whatever that 1913 Syndicate had, and in all causes of action that had accrued to this 1913 syndicate in the interval of its ownership. Therefore, this Minerals Separation North American Corporation, that now asks to be made a party plaintiff, while not the owner of the legal title to the patent, that remains in the Minerals Separation, Limited, at the present time, is the owner of the beneficial interest in that patent, and is therefore in equity properly, and rightfully to be included as a party plaintiff; and for the purpose of the accounting that we anticipate, should be a necessary party plaintiff to the end that the defendant itself may be protected from any further litigation connected with the same acts of infringement of this patent. And that is the purpose of bringing in this new plaintiff at this time, in defend~~ant~~ce of the defendant, so that every possible interest that has any equitable right of any kind in the accounting shall be actual parties to the accounting and bound by it. On the face of the papers the proceedings occurred

as of the date October 6th last and December 7th last. It hardly appears that any additional affidavit of diligence need be filed as to the delay in the interval because no possible harm can have been occasioned the defendant by that, and this bringing in of this corporation makes the pleading now accord with the facts that were brought out for the first time in the testimony of Mr. Ballot. These are facts occurring then since the bill was filed, having to do with an equitable interest that will be concerned in the accounting and is properly brought in this form of pleading.

As to the amendatory character of the bill, it consists of two measures; first, as to the Hyde and the relations of this defendant to the defense of the Hyde suit. We strike out by this amended bill our allegation in that regard in the original bill and substitute an amended allegation, stating the facts as we now understand them, making the pleadings agree with the proof, the proof that has been brought out here in the last few days, and which we could not in the nature of things, have ~~been~~ known until we saw this correspondence and examined these witnesses. That part, therefore, of the amendment is merely to make the pleadings agree with the proof.

And, finally, there is only one branch left, and that is a residuary interest, a certain residuary equitable interest in a third and the original American Syndicate that is called "Minerals Separation American Syndicate, Limited," which is the British Corporation of 1910.

Counsel, in following back these complicated title

papers connected with these three successive American corporations, one of 1910, a British corporation, one of 1913, a British corporation, and finally this last one of 1916, an American corporation, discovered just within a few days for the first time that there was this residuary equitable interest, left hanging in the air, as it were, and never assigned to anybody, an interest that accrued—a right of action that accrued to this 1910 American syndicate, by reason of infringements occurring between October 10th, 1910, and October 10th, 1913, because as the papers show that we attached to this document, on October 10th, 1910, that first of the three American corporations became an exclusive licensee under the patent in suit, and so remained until October 10th, 1913, when its license expired by limitation, and when all other rights and interests that were vested in it, were, by the British counsel who prepared these papers, transferred to other interests and reverted to Minerals Separation, Limited. But there was omitted from that document, as it chanced, such interest as had accrued to that first American syndicate of 1910 in the recoveries that might be made against infringers who infringed during that period, that is, from October, 1910, to October 10th, 1917. That happens to leave a small part of the infringement that will have to be accounted for here, in case a final accounting is decreed, and while an exclusive licensee under the authorities can not maintain an infringement in his own name—

MR. SHERIDAN: Oh, yes, he can.

MR. KENYON: It can properly be joined with the

owner of the legal title in such an action for infringement. That is correct, isn't it?

MR. SHERIDAN: Yes.

MR. KENYON: The question of the legal title and the question of exclusive license for the period mentioned, that old syndicate of 1910 may properly be joined as party plaintiff, and that syndicate, which otherwise is now defunct, but still legally in existence, asks to be permitted to intervene here as a party plaintiff, to the end that even that interest, whatever it may be, and remote though it be, may be represented in the accounting, so that the defendant may never at any time hereafter be called upon by that ancient corporation to respond in damages for that infringement. That covers the whole substance of our amendment and supplemental bill, and seems to properly amend and supplement the pleadings, so that all interests, equitable and otherwise, that might by any possibility be concerned in that accounting shall be before the court and bound by whatever that accounting results in once and for all. If counsel for the defendant are not inclined to accept our statement—the statement of counsel I mean—that this residuary interest of many years ago was unknown to exist by the British counsel and unknown to the parties themselves and only brought to light by our investigation here recently, we will present an affidavit to that effect, or testimony in court. Now, that, it seems to me, is the only possible point on which any affidavit as to diligence would be required.

MR. KREMER: After hearing the statement of counsel I ask leave to supplement my objections by three additional objections.

Defendant further objects for the reason that under the statement of counsel, an attempt is being made to split the causes of action; for the further reason that under the statement of counsel the pleadings should not be permitted to be filed because, assuming that an accounting should be ordered—only assuming this by way of argument—it would be improper to permit this pleading to be filed, because, this being the date of the application for filing the alleged supplemental bill, under the statutes of the United States it would be impossible or improper to permit anyone, either the plaintiff or any one of the proposed plaintiffs, in the supplemental bill, to ask for an accounting for a greater period than six years, as the statute of limitation prescribes a six years' period for an accounting, and the six years would run back from today.

For the further reason, that this being an action in injunction and accounting it is improper to permit any party to intervene who has nothing more than an action at law, if an action at all, and it is an attempt to permit a party to become a party plaintiff whose right of action, if any, would be confined to an action at law, an action for damages. I am now referring particularly to the last corporation—I can't keep track of their names—I think it is the Minerals Separation North American Corporation.

Having added those objections I would like to reply briefly to counsel.

At the outset, if your honor please, it was stated that the paper submitted was offered for the purpose of pleading a disclaimer. Such a position can not be ten-

able upon the face of this record. There has been filed here a proper supplemental answer, setting forth the fact that the plaintiff in this case did not file a disclaimer. Under the rule it is unnecessary for them to reply thereto and that issue is before the court regardless of their proposed supplemental bill, the question of whether or not a disclaimer was filed. That matter is before the court under the rules of practice, and the issue is joined.

Now, insofar as the pleading of the mandate of the Supreme Court of the United States in the Hyde case is concerned, the final decision in the Hyde case is pleaded upon the face of the record heretofore existing, and it is unnecessary to plead the mandate of that court. It is not the mandate that gives the decision any force or effect, and there is no attempt in this case and has been no attempt to admit the face of the record in the Hyde case. The existence or possible existence of that mandate would not give force or effect to any action that the plaintiff could take under this supplemental bill that they could not have taken under the original complaint herein on file, and particularly under the supplemental answer filed by the defendant herein. Therefore I say that there is no reason for the statement to the effect that this bill is made necessary by reason of a necessity of pleading the disclaimer or the mandate. The matters are before the court by implication of law, and there is no reason for tendering the supplemental bill at this hour. That this is in fact a petition for intervention, I take it that it can not come before this court in the guise of a supplemental

and amended bill of complaint. There is a vast distinction between a petition for intervention and a supplemental complaint or an amended bill. Why, I say a vast distinction—one is the antithesis of the other, in this, that the petition in intervention is addressed to this court by a stranger to the proceedings, who asks leave to come in and have his cause litigated in the cause between these other parties. The supplemental bill is a proceeding, which, under the discretion of the court in proper cases, might be filed for the purpose of permitting then existing litigants to set up in the record something that has transpired subsequent to the filing of the original pleadings and the joinder of the issue. An amended complaint is a pleading directive in the nature of a curative character, to a pleading already in existence; and if this is, in fact, as counsel now states, a petition in intervention, it can not be offered to this court for filing in this guise.

Now, as to these various corporations I think that I was stating the case quite correctly. Regardless of the recontation of these various rights, of these corporations at various times, the fact remains that these matters must have been known—and I am not speaking of counsel, because I take the statement of counsel that they did not know—but it must have been known to the officers of these corporations who, as I understand it, are extremely closely allied—I am not sufficiently familiar with the organizations to make the broad statement that they are the same—but these facts must have been known to the plaintiff, and there is no showing that they were not known to the plaintiff. It is not a

question whether counsel knew; the client may have withheld information from counsel, with design—I am not saying that they did, if your honor please, but I am only illustrating that the knowledge of counsel is not necessary. The very paper that is here presented admits that these contracts were in existence.

Now, then, the equity of this situation, — What is it? Before proceeding with the amendment, I would like to digress here to discuss the matter of this so-called supplemental bill. What is the equity of the situation? Suppose, if your honor please, this case had gone on without our discovery of this condition—and I use the word discovery of this condition advisedly—without our discovery of this condition, and let us suppose that that condition does exist, that in this litigation this patent will be declared invalid. When that decree is entered, decreeing the invalidity of this patent, what would have been the position of this defendant? Would not the Minerals Separation North American Syndicate, or Minerals Separation North American corporation, or any one of the other shadows that have lurked in this darkness, protruded themselves into the light of day and say "No, you are not relieved, because I claim a right, and you must litigate this all over again." Now, that is the position. These facts were known to them. It is the clearest case of doing equity that I have ever known. They come into equity and ask equity, and at the same time they have withheld the real parties in interest in this litigation, and it was only when we, in opening our defense, called to the stand the president of one corporation and chairman of the board of the other, and brought into this record the fact that

there was still another party in interest. Now, that is the reason. There is a strong reason in equity that these things should not be done, and we seriously oppose the filing of this so-called supplemental bill at this time.

I don't want to needlessly take up the time of the court; I think I have stated my position as clearly as I can, but now, directing my remarks to the amendment or the portion of the bill designated as an amendment to the original bill: In the original bill they complain in paragraph 8—In that paragraph everything is set up, if your honor please, that is set up in paragraph 8, except the recontation, or at least an attempted narration of the plaintiff's interpretation of certain evidence in this case, which they have made in this proposed amendment. In paragraph 8, I objected to the introduction of testimony under it, as your honor will remember, and argument was had, and my objection was overruled.

(Counsel read paragraph 8.)

In paragraph 8 in the amended bill, all that they have attempted to do, and I believe counsel will agree with me in this statement, is to give their interpretation of the evidence. They may not subscribe to my interpolation of the word "interpretation" either, but it is their view of the evidence that is attempted to be set forth in this so-called amended bill, and it is improper because it is a pleading of their interpretation of the evidence. There is no reason on earth why this amendment should be filed. The issue, I submit, is raised by their paragraph 8 in this case, because your honor has ruled that

it is properly in this case. Now, that being the state of the record, it is a useless thing and an improper thing to permit an amendment which sets forth merely an interpretation by the plaintiff of the evidence in this case, and we believe that, if your honor will examine the two paragraphs, that you will conclude that it is nothing more than—

THE COURT: In spite of the ruling which was made, they may think it wise to throw out an anchor to windward. There may be an appellate court.

MR. KREMER: There is no reason, and there is no rule of pleading to permit the introduction into a pleading of an interpretation of the evidence. If it does state a condition which will permit them to have redress if they have been aggrieved, that is sufficient in law. They have set forth here an interpretation of the evidence. Now, I desire, to add this, before concluding; that in addition, after they have set forth their interpretation of the evidence, they say that to that extent—that is to say, to the extent of the letters patent in suit, 835120, may vary as to claims 1, 2, 3, 5, 6, 7 and 12 and I included by the acts and operations that are complained of, that this defendant is estopped. You see? Leaving out of the matter of their attempted plea of estoppel, claims 9, 10 and 11. I think I have correctly stated that.

MR. GARRISON: Those are the ones that are left out?

THE COURT: The new one excluded 9, 10 and 11.

MR. KREMER: Yes, sir, the new one excludes 9, 10 and 11. I think I should state this to the court, be-

cause that is the legal effect of this amendment, aside from the fact that this interpretation of the evidence is here incorporated. I am not going to read it, but I have read the short paragraph which sets forth not what entitles them to redress but merely the so-called evidence or their interpretation of the evidence which they claim to have been introduced in this case. Now, I can not see the necessity of such an amendment, if under the original pleading all of the claims are included; this would serve no good purpose by way of relinquishment, because the law would relinquish them, and we submit that this supplemental bill is an improper document to be filed at this time, and that it is improper to combine the various elements there which are sought to be combined in this pleading, and there is no sufficient showing that the bill should be filed.

MR. KENYON: May I state just a word on one or two of these points? On the second day of the trial we gave defendant's counsel informal notice that we would prepare a supplemental bill, and there was some discussion connected with it, and this is the outgrowth of that.

MR. KREMER: Mr. Kenyon, I very much dislike to interrupt counsel, but may I ask you the question to avoid the necessity of rising again? Wasn't that notice given after Mr. Ballot had testified?

MR. KENYON: I think it was.

MR. WILLIAMS: Yes, a few minutes afterwards, and I think that we should also say that counsel considered the matter on the train coming out here, and decided to file a supplemental bill as soon as they could study the numerous documents and reach a conclusion

as to what was necessary to give to the defendant that protection which would arise from including all the parties who had any action against the defendant.

MR. KENYON: And we had to telegraph to the east to get some of these documents. Now, counsel speaks of a six year limit under the law. That is true. An infringement that occurred prior to six years before the filing of the bill of complaint is barred by the statute of limitations. Therefore, as to this 1910 corporation, there is no doubt that it could not prosecute an infringement occurring six years prior to the time, whenever this supplemental bill is filed. But that is a question of the extent of the infringement, a question to be properly brought before the master, and not a question to be determinative of whether that party could sue or not within the six years. It so happens here that it already appears in evidence in this case that the defendant's operations did not begin until the first of July, 1911, so it is merely a moot question here.

Now, as to the question of these two new parties here splitting actions, and that an exclusive licensee has an action only at law. In the second proposition, counsel is correct. When it sues alone it can sue only at law for damages that have been done to it, but nothing is commoner in the administration of patent law, and the books are full of illustrations of the proposition that an exclusive licensee, although alone he can sue only at law for damages, may be joined with the owner of the legal title in a suit in equity for that same infringement, and when so joined can participate in the prayer for injunction and in the accounting for the profits, as well as for damages.

Therefore, this that we propose is not a splitting up of actions, but just the reverse, a consolidation of actions. It is a non-splitting of actions; it is a consolidation of all of them into one action whereby with one proceeding and one accounting every right and every obligation of these defendants, and of all these plaintiffs shall once for all be determined. Defendant's counsel illustrates: Suppose we had kept these equitable interests in the dark, and had proceeded in the name of the owner of the legal title only and had in the end invited the catastrophe of a decree declaring the patent invalid that then we might have brought suit in the name of one of these exclusive licensees and sued all over again. We are quite anxious to save him from that possible disaster. We are—we ask that the exclusive licensee be joined here so that it will be bound by that decision and never again be able to raise its voice. That relieves him and protects him. This court, under its own rule 19, has the broadest discretion in the matter. "The court may at any time, in furtherance of justice, upon such terms as may be just, permit any document, proceeding, pleading or records to be amended or material supplemental matters to be set forth in an amended or supplemental proceeding. The court at any stage in the proceeding will disregard any error defect in the proceeding which does not affect the substantial rights of the parties." Now, our opponent says it is not necessary to plead the decree in the Hyde case.

MR. KREMER: No, not the decree.

MR. KENYON: The disclaimer?

MR. KREMER: No, the mandate.

MR. KENYON: Then it will do no harm to plead the mandate. Pleading the decree explains the decree; pleading the disclaimer and the interval between the two explains at all times the disclaimer and the final decree; and that a disclaimer can properly be treated is also permissible and is often done. In Fellows v. Borden, 205 Fed. 901, the Circuit Court of Appeals, Second Circuit, allowed the plaintiff to ask the district court to file a supplemental bill after a disclaimer, in order to set up the disclaimer, and the District Court allowed it and it was filed and the case was reheard on the merits and went to the Circuit Court of Appeals on the merits of the treating so amended. And as to the Hyde amendment, some of the allegations of our bill were incorrect. We wish them amended in accordance with the evidence. In some respects they were incomplete and we wish that incompleteness supplemented in accordance with the evidence, and made complete and the residuary right of this old 1910 corporation extended not only to counsel but to the parties themselves. They were ignorant of it until within a few days when we discovered this matter in conning over these numerous documents that were admitted in evidence; they were ignorant that anything had been left, any property had been left in that 1910 corporation. The purpose had been to absolutely denude it of every possibility, of every right of every kind. But this right of action and any interest in a right of action against infringers had during this period ~~had~~ apparently been a thing unknown to British counsel and had not been included in any of the general language.

We will, if your honor please, file an affidavit that the parties themselves were ignorant until within the last week or so, of the fact that there was any right of any kind with reference to this infringement left in the old 1910 corporation, if your honor wishes such an affidavit on file.

MR. KREMER: I don't think that that would excuse them at all. The fact that they did not know that which they should have known is not any excuse. It is purely a question of law and legal right and we can apply the basic maxim *ignora legis nemine excusat.* They cannot take advantage of a condition of that sort by saying that they did not know or they supposed the record had been left in that condition. They could have come in here and sued for it, and alleged recovery. I do not care to take up the time of the court, but

P. 3331, L. 18, insert " concerned the only excuse offered for this amendment is " after " is "

forth more nearly the state of facts. That is not a sufficient excuse. As a matter of fact, neither the complaint nor the amended complaint states the facts or any portions of the facts as disclosed by this present record before the court. The unimpeached record before the court at this particular time, in this case, is that Mr. Hyde had sold his rights, and that the Butte & Superior had purchased them for an expenditure equal to the amount of the cost of the litigation. There was no evidence of the control of the litigation or anything of that sort. Now, we submit the matter.

THE COURT: Does this supplemental bill purport to take the place of the original bill or simply an addition to it?

MR. KENYON: An addition to it only in respect to one paragraph, paragraph 8 does amend it.

THE COURT: Well, the main feature seems to bring in these parties who have a right to share in the fruits, if there are any, for the plaintiff. There is an old maxim that courts of equity delight to do complete justice and not by halves. I will take the two pleadings and look them over and dispose of them in the morning. You may proceed with the case.

BEN. H. DOSENBACH resumed the stand for further

DIRECT EXAMINATION.

Q. 81. Mr. Dosenbach, have you ever investigated the possibility of concentrating by flotation and a froth with the same amount of oil that is recognized for this Cattermole process in which the mineral is sunk?

A. I have.

Q. 82. How have you proceeded with this investigation?

A. I have performed an experiment in what is called the cone Gabbett, using a proportion of oil to ore that is over one per cent and which is very close to the proportion recognized in the Cattermole patent, that being 4 to 6 per cent relative to the metalliferous mineral content. The amount of oil relative to ore that I propose to use and that I have used is one and one-half per cent, which reduced to proportions compared to the metallif-

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erous mineral content is about seven per cent. In the experiment I performed I used oleic acid and Butte & Superior ore.

Q. 83. Suppose you just describe the procedure before you do it so that we will know what to look for?

A. In the experiment that I am about to perform in the cone Gabbett machine, using a proportion of oil that is over one per cent and also a proportion of oil recommended in the Cattermole patent, I will use 300 gms. of Butte & Superior ore containing about 14.8 per cent zinc. I will add to that 1500 c.c. of water at a temperature of 35° C. I will use also 1 c.c. of sulphuric acid concentrated and 5 c.c. of oleic acid, which is equal to 4.5 gms. or one and one-half per cent relative to ore. The agitation will be continued for possibly six minutes, at a speed of 1600 to 1700 revolutions per minute.

Q. 84. And what will the result be of that first agitation?

A. The result will be a froth.

Q. 85. And then what do you propose to do after you have obtained that froth?

A. I will reduce the agitation and it will be noted that the mineral sinks. And, by again increasing the agitation it will be noted that there is a froth formed.

Q. 86. A second froth?

A. A second froth.

Q. 87. And who will—and how will you conclude the demonstration?

A. I will conclude the demonstration by reducing

the agitation again, sinking the mineral and separating the mineral in an upcast, as is done and recommended in the Cattermole patent.

Q. 88. And all of these operations will be conducted in the very same mixture?

A. They will.

Q. 89. Now, as I remember the Cattermole patent refers to the quantity of mineral, the metalliferous content of the ore. That expression does not mean the mineral itself, zinc?

A. Refers the oil to the metalifferous mineral.

Q. 90. What is the metalliferous mineral in zinc ore?

A. The sulphide of the metal.

Q. 91. You gave its contents 14.8 zinc. Is that metallic zinc?

A. Metallic zinc.

Q. 92. And how much of a per cent of blend in which that zinc is contained that is taken into account, the weight of the sulphur contained with the zinc?

A. 21.75 per cent metalliferous mineral or zinc sulphide would be equivalent to 14.8 per cent zinc.

Q. 93. Now the oil is one and one-half per cent of the weight of the ore and the ore contains approximately one-fifth metalliferous mineral, that is a little over twenty per cent?

A. Yes.

Q. 94. So that you arrive at the relation of the oil to the metalliferous mineral by multiplying that one and one-half per cent by approximately five?

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A. Yes. In actual figures it is less than five so that the amount of oil relative to the metalliferous mineral present or the zinc sulphide amounts to 7.0—something which is just a little above seven per cent.

Q. 95. Now I think you may proceed with the experiment?

A. If a representative of the other side is here we will give them a sample of the oil we are going to use.

(Performing Test #33.)

I have now placed into the cone Gabbett machine 300 gms. Butte & Superior ore. I will now add 1500 c.c. of water at a temperature of 35° C.

MR. WILLIAMS: I would like to give notice to Mr. Scott of a request for a little specimen of each of these froths that is to be made. I think one-tenth of a gramme of each will be satisfactory to us if that will not interfere with the operation.

THE WITNESS: It will be a pleasure to give it to you. After having added 1500 c.c. of water I will add 1 c.c. of concentrated sulphuric acid and will also add 5 c.c. of oleic acid and will start agitation.

Q. 96. MR. SCOTT: Now, Mr. Dosenbach, just state what the result of that experiment has been.

A. After stopping agitation, having agitated the mixture for a period of six minutes, a highly mineralized froth appears on the surface and the tailings are now settling and are very clear—appear to be very clean, and are comparatively light in color, settling very rapidly. The mineral froth that was formed is about one and one-eighth inches in thickness.

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Q. 97. Now, Mr. Dosenbach, you are next going to remove the baffles?

MR. SCOTT: I would like to have your honor see the process that goes on when he removes the baffles.

Q. 98. Mr Dosenbach, will it interfere with you at all if you would agitate it with the baffles in before you do it?

A. No.

MR. SCOTT: He will give it the same agitation he did to make the froth, for a few seconds, and then he will change the agitation for the next step. That is the way he made the froth, with the small baffles in.

Q. 99. Now, go ahead with the next step so the court can see the difference in the way of agitating it.

A. It has a sort of a honey-comb structure on top, pitted.

Q. 100. What do these pits come from?

A. The release of certain air that allowed these pits to form.

Q. 101. What have you just done with the belts?

A. I have changed belts so as to get a lower speed. This rheostat and motor would not allow for a slow speed.

Q. 102. The speed before was about 1700 revolutions per minute?

A. No, I took the speed to be 1450 while it was operating.

Q. 103. Now it will be what?

A. About 300.

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Q. 104. You are going to leave the baffles in?

A. Yes, I am going to leave the baffles in.

Q. 105. How long are you going to agitate it this time?

A. It usually takes five to ten minutes to take the air out of there, out of the pulp.

MR. SCOTT: Let the record show that the agitation was stopped in five minutes.

Q. 106. And then what happens, Mr. Dosenbach?

A. The mineral sank to the bottom; there was no semblance of a froth present on the surface.

Q. 107. MR. WILLIAMS: Just a few little particles here and there?

A. Just a few little particles here and there, possibly ten or twelve.

Q. 108. MR. SCOTT: Now, what do you propose to do next?

A. I will increase the agitation as agitated before and the result will be a froth or I hope it will be.

Q. 109. And after that you propose to form the granules again and separate them in the up-cast?

A. Separate them in the upcast. You can see that the mineral has sunk to the very bottom.

Q. 110. Just show the court the upcast before we go any further.

A. The upcast is a sort of a classifying arrangement whereby these heavy mineral particles that have now settled in the Gabbett—

Q. 111. Coming in here?

A. They will be emptied into the classifier or upcast.

Q. 112. And what is this tube leading into the bottom?

A. That is water that is fed from the tank up above, which supplies a flow sufficient to cause the hydrulic action in the upcast.

Q. 113. The water will come up through the glass tube?

A. It will and carry with it the light gangue material you see now in the machine.

Q. 114. And what will become of the granules?

A. The granules will sink to the bottom and be caught in the bottom, which is this part of the upcast.

Q. 115. And these granules will be the same material out of which these forths have been formed?

A. Absolutely. I have again agitated the mixture for one minute at the same speed as before, being about 1450 revolutions per minute.

Q. 116. When you say "as before" you mean as when you formed the froth before?

A. When I formed the froth before, at 1500 revolutions per minute, and the result was a froth of the very same character as obtained before.

Q. 117. You might simply continue with the last step?

A. You notice along the side of the froth the clear portion on the particles of the froth which are

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evidently air bubbles, and it shows the clear portion where the froth sticks to the side of the glass.

Q. 118. What do you mean by the clear portion?

A. That is quite distinct, here is one and there is one.

Q. 119. You mean the black spots?

A. Yes, where there is no mineral present. Would you like a sample of that?

MR. WILLIAMS: We might. We might get some information out of it. Let us have it.

Q. 120. MR. SCOTT: You ran this the same five minutes you did before?

A. No, it takes longer.

Q. 121. Why should it take longer?

A. It takes longer to form the granules than it does to form the froth because in working with a Cattermole machine, the cone Gabbett, it carries in quite an extensive amount of air through the cone and naturally during the process of agitation there will be a considerable amount of air taken in.

Q. 122. Referring to the fast agitation, or either of them?

A. Either one of them, for a short period. And it is in order to displace the air that is taken in after the first agitation that the slow rolling of the second period of agitation is necessary to be continued for a considerable length of time.

Q. 123. To get all the air out?

A. To get all the air out.

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Q. 124. MR. WILLIAMS: That is, that your present operation is one to get rid of the air?

A. Yes.

Q. 125. The machine introduces air at the same time?

A. Yes, it is very efficient for introducing air.

Q. 126. MR. SCOTT: How does the amount of air introduced when it is going slowly compare with the amount introduced when it is running rapidly, as you did when you were making the froth?

A. Very much less when it is slowly revolving as compared to when it is rapidly revolving and the froth is formed. I have agitated for a second period of five minutes and the result has been that there is no froth present. All the mineral has sunk to the bottom of the vessel. I will now proceed to separate ths sunken mineral by the upcast classifier arrangement. The heavy particles are sinking and the gangue particles are going up. This (indicating) showing of the distinct mineral particles being heavier, and the slime gangue particles being the lighter here (indicating), are carried over by the up-current of water.

Q. 127. Have you got a stirrer so you can stir up those tailings so the court can see them?

A. I can catch some in my hand. I will allow them to settle a few minutes, and when the slimes have settled so there is an appreciable amount at the bottom, they can be noticed. There are a few floating particles of mineral in the upper part of the upcast

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at the time that I am draining it. You can now see the mineral and granules that have been separated in the upcast; they all occupy the lower portion of the upcast, or the bottle.

Q. 128. Does that look like a clean separation?

A. Yes, a decidedly clean separation, especially so in the apparatus that I used, being a small apparatus.

Q. 129. Are you going to sample it?

A. Yes, I would be very glad to sample it and give the other side an equal portion of the sample. I will allow the tailings from the overflow of the upcast to settle, so you can notice its condition, being deprived of the mineral.

Q. 130. I don't think you described the other portion of the operation in the upcast. I think you had better give a description of that, of the upcast and the bottle and the launder and just how you operated.

A. The upcast consists of a vertical cylinder about two inches in diameter and about 30 inches high, to which at the lower end is attached a bottle, and through which hydraulic water is introduced, causing an up-current through the vertical cylinder.

Q. 131. That was clear water?

A. Clear water which acted as an upcast, so that when the total material from the Gabbett machine was introduced into the top of the cylinder or upcast, the uprising current of water carried the lighter portions of the mixture, which was the gangue material, up to the topmost portion of the cylinder, where it over-

flowed into a receiver. The heavier portion, being the mineral, sunk in the presence of the uprising current of water, and was collected in the bottle at the lower end of the cylinder.

Q. 132. And in what condition was the mineral collected in the bottle at the lower end of the cylinder?

A. The mineral that was collected in the bottle at the lower end of the cylinder was in a decidedly pure state, containing very little gangue material, or insoluble.

Q. 133. On Saturday you performed an experiment with 25% of oil, petroleum distillate, relative to ore, which was Utah Copper retreatment classifier overflow. I won't ask you to perform another experiment of that kind, but have you done a similar demonstration with Butte and Superior ore?

A. I have conducted a similar demonstration using the Butte & Superior ore.

Q. 134. Can you give an approximate description of the details of that experiment?

A. In that experiment that I performed I used 300 grams of Butte & Superior ore, 1500 c.c. of water, at a temperature of about 30° Centigrade, one c.c. of concentrated sulphuric acid, 75 grams of kerosene, which is the equivalent of 25% of oil relative to ore. This experiment was performed in the square glass jar machine, and the agitation was continued for approximately three minutes at a speed of about fourteen to sixteen hundred revolutions per minute. The result of that experiment was a very copious froth contain-

ing the zinc sulphide mineral, and showed a very good degree of concentration.

Q. 135. Can you give descriptions of the demonstrations that will be illustrative of the present mill practice on the Butte & Superior ore; I don't think I will ask you to do them, but I would like you to give the details of the operations, one in using less than 1% of oil and another more than 1%.

A. I can. I have performed several experiments of that nature and I can repeat the same if so desired.

MR. WILLIAMS: I think that if we are going to have any testimony as to experiments which illustrate the operation of the Butte & Superior—While I don't want to take up the time of the court unnecessarily—still, it does seem to me that we ought to have the experiment rather than the secondary evidence of the description by the witness.

MR. SCOTT: Well, I will have Mr. Dosenbach perform the experiment if you wish. My idea was to have him give the laboratory proportions and procedure and leave it with you if you wanted to consume the time to see them.

MR. WILLIAMS: All right, we may do it that way.

MR. SCOTT: I might suggest at this time that we have thought it would be very informing if the court would visit the Butte & Superior mill simply for an ocular impression of the process on a large scale. If the court is willing we would be very glad to ar-

range for that. I am not informed as to whether the court has actually seen the flotation operations on a large scale or not.

THE COURT: No, I haven't. Well, I don't know —of course I am hopeful that I will be sufficiently educated for a metallurgist before I get through; but whether I am yet ripe enough to judge by looking at the process I am not sure. Do you think it will assist me?

MR. SCOTT: It always gives me more of a grasp of things of this kind if I can see them in actual operation. There are many things that we have to explain that will be more clear by seeing it. Of course in the mill these froths do not accumulate in these masses that we see here, and then have to be taken off all at once, but there is a constant movement through the cells, and the froth is constantly overflowing a lip as it is being formed.

MR. GARRISON: I would like to suggest to your honor, that if you do think well of inspecting of the procedure at the Butte & Superior, that you, at the same time inspect the proceedings at the Timber Butte mill, which is using ore from the same vein, and is avowedly using our process, being a licensee of ours, and where the amount of oil is from one-half to three-quarters of a pound to the ton of ore.

THE COURT: Well, some time during the progress of the hearing we will try and do that.

Q. 136. Now, could you give a description of what

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you think is the best illustration of the procedure at the mill?

A. A description of the process that would be applied in a small apparatus as being descriptive of the operations at the Butte & Superior plant would be an experiment carried out in the Janney machine, which is this machine that I refer to, the Janney Flotation Machine. This is the machine that is now being used at the Butte & Superior flotation plant, and in carrying out the experiment I would use about 30 pounds of oil to the ton, or 1½% of oil mixture.

Q. 137. What are the ingredients of the mixture. I take it it is the same mixture used at the Butte & Superior?

A. Substantially so, yes. 70% of fuel oil, 18% of pine oil and 12% kerosene. The proportion of ore to oil that I would use would be 400 grams of ore and about 2000 c.c. of water. I would use sulphuric acid and copper sulphate, as both are being used, and the exact proportion of sulphuric acid to 400 grams of ore would be .9 of a cubic centimeter. I would also use 1 c.c. of copper sulphate solution.

Q. 138. What does the copper sulphate do?

A. The copper sulphate assists materially in the recovery and grade of the concentrate produced. It assists the acid in its action.

Q. 139. Is the use of copper sulphate to your knowledge recommended by any of the literature of the art?

A. Yes, I have found in the Everson patent the use of copper sulphate is recommended as being one

of the salts that can be used in place of the sulphuric acid or together with the sulphuric acid. It is very distinctly brought out, the use of the various salts in the Everson patent. With 400 grams of ore I will use 6 grams of oil mixture, which is equal to 1½% relative to the ore, or 30 pounds per ton of ore. This operation carried out in the Janney machine will show to a great extent, and as near as possible the laboratory method setting forth the actual practice.

Q. 140. This Janney machine comes nearer illustrating the mill operations than the jar, doesn't it?

A. Decidedly so, yes, because during the operation of the Janney machine the froth may be taken out as it is being agitated and brought up to the surface; consequently it is not necessary to stop agitation and let the froth rise to the surface and then be skimmed off; but it can be done as it is being agitated and flowing into the spitzkasten—the froth can be taken off. Now, it might be well to show a comparison of the two experiments, using the same proportions of oil to ore and reagents in the square glass jar, as against the Janney machine.

Q. 141. Have you the motors so that you can do both at once?

A. Yes, I think I can do both at once.

Whereupon further was adjourned until 2 p. m.

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2 p. m. April 30, 1917.

MR. GARRISON: With the permission of the court, may I ask for the response of Mr. Kremer as to the result of his search?

MR. KREMER: I beg your pardon, Mr. Garrison, I entirely forgot to inquire. I will go and inquire immediately.

MR. SCOTT: Mr. Dosenbach was about to perform two experiments, if your honor please, representative of the oil mixture in the quantities used in the Butte & Superior plant, and he has arranged to do both of these experiments at once to save time that would be consumed by doing one after the other. He will do one of the experiments in the Janney machine, and in doing it he will try to take off part of the concentrate first, representing what is taken off in the real machine first, and then in a separate basin will take off the rest, which will represent the middling, or the material which is returned. In this glass jar machine he will use the same mixture and the same ore, to illustrate the difference between those two ways of doing it.

(Test in Janney machine, test No. 34. Test in glass jar machine, test No. 35.)

THE WITNESS: I think I have stated what I will use; the percentage of the oil mixture in each instance will be 1½% relative to the ore. I will start the square jar machine and let it continue while carrying on the operation in the Janney machine, and by the time the latter is finished the other will be finished.

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(Both machines running.)

THE WITNESS: What I am doing now, scraping off the froth from the Janney machine, represents what the scrapers do. In the actual plant there are scrapers which carry off a little of the froth every time it comes around; otherwise it would pile up and come over the sides. I will stop it now and take this first concentrate, if anybody wishes to see it.

This second basin, its contents represent the middling, or approximately so; although, in the lower stages of the actual machine we take the middling product after taking off the richer product that comes off first. This of course is a very much lower grade froth than is the actual case in the machine. In the mill the lower machines take off the middling, there being less mineral in the ore at that time. As a matter of fact in an operating plant we have the water level raised much higher than this; in the latter part of the machines it is higher than in the first part of the machines, which I show now. (Adding water.) Now, this is the water level about up to this point, and in the last cells the water level is much higher. This shows a froth coming off now in which there is very little mineral, which can be seen by the clear bubbles. There being very little mineral present, there will not be much mineral in the froth.

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(Going to the glass jar machine.)

Here is the froth that was made in the glass jar machine with the same percentage of oil. The only thing that we had reference to in this experiment was to show—was that there might be criticism about some of the oil going off during the first operation in the Janney machine, and this experiment is to show the similarity between the froths.

Q. 142. MR. SCOTT: What causes the bubbles to break down in the Janney machine so quickly?

A. There is no more agitation.

Q. 143. And what is left there?

A. There is very little mineral left; most of the mineral has been taken off, consequently this is a very good tailing, which I should be glad to have analyzed. The bubbles and possibly the froth before the machine was stopped showed that they were clear, and that very little mineral was contained in them; consequently when the agitation was stopped, the bubbles broke down.

That will complete the experiment, with the exception that I would like to take off the tailings at this point. We will number this station No. 1, the concentrate, and this will be the middling, No. 2, and I will also give one-half of these products to the plaintiff. Now, we will take out the tailing from the Janney machine and see what it looks like. (Taking out material from Janney machine.)

Now, I will put some of this fine slime into this other pan, since one pan will not hold it all, and

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later we will combine the two of them and half will be given to the other side. Now, what is in this pan shows very distinctly the poorness of the tailings. It is very light in color, and we will assay that and see just what it contains. It shows that the tailings are comparatively free from mineral. If it contains very much mineral after this action, the mineral would be noticed very distinctly and it can be seen that it has the same consistency throughout and is very light in color, showing that the mineral is gone.

Q. 144. Mr. Dosenbach, you better briefly describe the complete operation performed. I am afraid it is a little fragmentary the way it is in the record now.

A. The two operations that I have just completed are as follows: The one operation was carried out in the Janney machine and purports to set forth the operation as conducted at the Butte & Superior plant inasmuch as laboratory apparatus is concerned. The proportions of material used in the Janney machine experiment was 400 gms. of Butte & Superior ore containing approximately 15.9 per cent zinc; 1900 c.c. of water was used at a temperature of 30° C., 0.9 c.c. of concentrated sulph~~ide~~uric acid was used, which is equivalent to about 8 lbs. of sulphuric acid per ton of ore. 1.0 c.c. of copper sulphate solution was used which is equivalent to about 0.1 pounds of copper per ton of ore, metallic copper. 6 gms. of oil mixture was used. This oil mixture consists of 70% fuel oil, 18% pine oil and 12% kerosene. The agitation

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consisted of approximately thirty seconds of mixing the oil with the ore and other reagents, and one minute and a half approximately for the period during which the concentrate was taken off and two minutes and a half constitutes the period during which the middling was taken off.

MR. WILLIAMS: Will you describe what you did in that period of the operation where you said there were 30 seconds of mixing.

A. During the period of thirty seconds of mixing the ore, oil, acid and sulphate were mixed by the agitation of the impeller blades in the machine for a period of thirty seconds.

Q. 145. And you confined these materials to the agitating chamber, did you not, during that particular operation?

A. I did, yes, the same as I would put them in the agitating mixer and add additional water later to fill up the spitzkasten. After discontinuing agitating the mixture and the middlings having been removed, I removed the tailings and all products will be assayed to determine their value. In the square glass jar machine at the same time that I performed the experiment in the Janney machine I performed an experiment wherein I used 300 gms. of Butte & Superior ore containing approximately 15.9 per cent zinc; 1500 c.c. of water at a temperature of 30° C.; 4.5 gms. of oil mixture consisting of 70% fuel oil, 18% pine oil and 12% kerosene, this oil mixture being the same as I used in the Janney machine during the experiment

that I performed in it. I also used 0.81 c.c. of copper sulphate solution which is approximately 0.1 pounds metallic copper per ton. I used .67 c.c. of concentrated sulphuric acid, which is equivalent to approximately 8 lbs. or 8.25 pounds of sulphuric acid per ton of ore. The agitation was continued for the same length of time as the total agitation in the Janney machine experiment. After discontinuing agitation in the square glass jar machine a highly mineralized froth formed on the surface, being composed of zinc sulphide and innumerable air bubbles. It shows a very good froth and the tailings as they have settled now are comparatively clean but the structure of the froth itself on the surface shows very distinctly the number of air bubbles that are present (exhibits sample to the court).

Q. 146. MR. WILLIAMS: I have no note of the temperature that you used in the Janney machine experiment?

A. 30° C.; 30° in both experiments.

Q. 147. MR. SCOTT: What would happen if you were to make a froth with say .2 per cent pine oil and then were to add enough to bring it up to one and one-half per cent and agitate again?

A. Well, I haven't done any experiment like that myself, I couldn't say—using pine oil?

Q. 148. Pine tar oil?

A. I have with pine tar oil, yes, sir.

Q. 149. Now, what would happen with pine tar oil?

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A. I have made an experiment like that and was curious to find out just what the condition—just what the addition of more pine tar oil would do after obtaining a result with a small quantity, to see whether there was any great difference between the froth that was obtained with a small quantity, whether a froth would be obtained with a large quantity, over one per cent, and to note whether there was any difference between the two, and I made a very interesting experiment just that way in the cone Gabbett machine, the machine that I used this morning in court to demonstrate the Cattermole process.

Q. 150. Then I think I will ask you to do that one more experiment, and then we will be through, showing the formation of this froth with .2 per cent of pine tar oil and after getting that froth simply pour in enough more to bring it up to one and one-half per cent and aerate and agitate it again?

A. I can perform that experiment very shortly. (Performing test No. 36.)

MR. KREMER: Mr. Garrison, while the experiment is being performed we can perhaps save some time. I have all of the vouchers here that we have in our possession—that is that we have been able to locate—I assume that they are all here because they cover a considerable period of time. Now, which of them do you desire to use.

MR. GARRISON: May I see them.

MR. KREMER: I will give them all to you and just put them in order and let me know.

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MR. GARRISON: I may put these in at some future time.

MR. KREMER: I can't urge you as to when you will put them in, but I wish you would look them over and use what you want to and return what you don't want.

MR. GARRISON: I will return them presently.

MR. KREMER: Those that you don't offer we will.

MR. GARRISON: I intend to offer all of them.

Q. 151. MR. SCOTT: Now, add enough to bring it up to one and one half per cent, that would be thirty pounds per ton?

A. Yes.

MR. SCOTT: Your honor will notice on top of this froth, the appearance of it, that is with the small quantity of oil.

Q. 152. MR. SCOTT: Now, suppose you go right ahead on that if it has stood long enough.

Q. 153. What difference do you notice between the froth of that with the 1½% approximately, and the one with 0.2 of one per cent?

A. The froth with 1½% approximately is of twice the volume that it was with the 0.2 of 1%. The agitation is about the same, and it shows plainly that there has been more mineral recovered by the addition of the extra amount of pine tar oil over and above what was in it at first, the 0.2 of 1%.

Q. 154. What do you say in regard to the produc-

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tion of froth with the added amount of oil as compared with the first case?

A. It is very similar; in fact the air bubbles on the side can be noticed, and the structure of the froth. There are a number of instances and places where the air bubbles are resting against the glass and are free from mineral, having discharged themselves by contact with the glass; that is noticeable all around. The froth with ~~.02~~ 0.2 of 1% was 1 inch in thickness, whereas this froth is about an inch and a half. These bubbles can be seen, and also the structure of the froth with this magnifying glass.

Q. 155. State what machine this was in, for the record.

A. I have stated that this machine that I performed the experiment in is a cone Gabbett, the same one that I performed the experiment in this morning of the froth and the granules separately. I wish to state that my intention was to increase the oil from two-tenths to one and a half, but in weighing it out I used more than the amount necessary to make one and a half, consequently the total amount of oil used in this experiment was 1.62%. I originally used 0.615 grams of pine tar oil in the first part of my experiment, and produced a froth of from three-quarters to one inch in thickness upon agitation. This froth was highly mineralized, containing zinc sulphide. I then added, after three minutes' agitation, which was the total length of time of agitation for the first part of the experiment, 4.25 grams of the same oil, and

continued agitation for three minutes. The total amount of oil was 4.865 grams, or 1.62% relative to the ore content.

Q. 156. BY MR. WILLIAMS: Have you given all the particulars of temperature and speed of agitation?

A. I will do so. It might be advisable to take off enough of the concentrate froth so as to give both parties an opportunity for analyzing the same so as to determine as to the purity and the grade.

MR. SCOTT: Let the record show that some of the froth was taken off and offered to plaintiff's counsel.

Q. 157. MR. SCOTT: Have you finished?

A. I think so, but I don't know whether I stated exactly what was used in regard to ore. I used 300 grams of Butte & Superior ore, containing about 14.8% zinc. I used 1250 c.c. of water at a temperature of 35° C. The amount of sulphuric acid used was 0.5 c.c. The agitation in each instance was carried on for three minutes at about 1750 revolutions per minute.

Q. 158. I believe you have prepared some statements of the operations of the Butte & Superior Company with larger and smaller amounts of oil. Can you produce such a statement for the period from 1913 to date?

A. I have a statement showing the results.

Q. 159. Can you supplement this statement by

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information regarding individual days operations if called upon to do so?

A. I can.

Q. 160. Were the operations during this period under your supervision—or part of this period?

A. From May, 1913, up to the present time, they were.

Q. 161. From May, 1913; that omits the first quarter?

A. That omits the first quarter of 1913, which is included in this record.

Q. 162. You have the records for that first quarter that you can refer to if counsel should want some information about the first quarter of 1913?

A. Yes, we have the records the same as we have for the succeeding period.

MR. SCOTT: I offer in evidence the table entitled "Butte & Superior Mining Company, Flotation Operations."

Table admitted without objection, marked DEFENDANT'S EXHIBIT No. 158.

Q. 163. The first column entitled "float. plant feed, ore to float. plant" just explain what these headings mean, will you, Mr. Dosenbach?

A. The first column, "Float. plant feed" under which is added "float plant. Dry tons and per cent zinc."

Q. 164. What is the difference between these two

expressions, "Float. plant feed" and under it "ore to float. plant"?

A. "Float. plant feed" means flotation plant feed; which also means ore to the flotation plant.

Q. 165. Mean the same thing?

A. They are synonymous, only it is to make less confusion. That is the actual ore that goes to the flotation plant.

Q. 166. That is the original material that goes to it?

A. The original material.

Q. 167. Now, the next is "flotation machine feed" and under it "ore to flotation plant plus circulating middling treated in flotation"?

A. That is the original material plus the circulating middlings which is present in the flotation plant itself.

Q. 168. Now, in that column which is entitled "Percentage zinc" under the—there seems to be no entries until the fourth line from the bottom. I presume that material was not assayed for zinc during that period?

A. Yes. For most of the time, and I can supply that for every day that we have it for, and for this period. But I haven't had time to make it up for these periods. It was left out by mistake.

Q. 169. But you can get it?

A. I can get it because we have daily assays on each day and I will supply it to fill out this sheet.

Q. 170. Now the next column "flotation concentrate,

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tonnage and per cent zinc" seem to need no explanation. That is simply what is indicated there?

A. Yes.

Q. 171. As well as "per cent zinc" the same. You might explain again the difference between this apparent and estimated recovery.

A. The apparent recovery and the estimated recovery are both given in these tables. The apparent recovery is the recovery that is secured from the assays of the head, tailings and concentrate by the formula which takes into consideration the assay of each one of the products. That formula is the concentrate assay times the head minus the tailing assay divided by the head assays times the concentrate minus tailings assay. The estimated recovery as given in the sheet is the amount of metal recovered in the concentrate divided by the amount of metal in the heading. That takes into consideration the pounds of zinc in the concentrate as compared to the pounds of zinc in the heading.

Q. 172. The acid column is sulphuric acid of course?

A. I think they need no explanation. It is merely the pounds of acid per ton and the pounds of oil per ton. That is the amount of oil added to the original ore.

Q. 173. "Per cent oil in ore and circulating middlings treated in flotation" that is an assay figure, I take it?

A. Per cent oil in ore and circulating middling treated in flotation is determined by oil assays.

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Q. 174. By direct assay of the oil content?

A. Yes.

Q. 175. And that appears to be the same in the last four lines as well?

A. Next column "Pounds oil per ton contained in ore and circulation middlings treated in flotation" is merely the calculation from the analysis which is given in the column preceding. The per cent oil in concentrate, the next column following is by oil analysis of the concentrate, the per cent of oil in the tailings by oil analysis.

Q. 176. Can you just, for illustration, give us an example of how that figure "pounds per ton contained in ore and circulating middlings" how that is figured from the data in the preceding columns? For instance, take the entry February 4th to 28th, we have 25.4 entered under the heading I just read "pounds of oil per ton contained in ore and circulating middlings." Can you tell us just how that is derived from the preceding figures there?

A. That is derived from the preceding figures by multiplying the preceding figure by twenty, there being twenty pounds of oil, equal to one per cent, in a ton. Consequently if the per cent oil in ore and circulating middlings treated in flotation is equal to 1.27 per cent, then it is merely a matter of calculation to determine how many pounds 1.27 is equal to.

Q. 177. The only difference between these columns is one per cent and the other is pounds per ton?

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A. Yes.

Q. 178. Well, have you any figures in this table —well now, take these two columns, one is percentage and the other one is pounds per ton. Where is the sample taken for assay which gives the oil here, 1.27 per cent for instance?

A. The sample is taken of the feed before it enters the machine.

Q. 179. That is after the middlings and initial feed have come together?

A. Yes, exactly so.

Q. 180. There is no calculation then about determining the total amount of oil per ton of total solids? It is simply a direct assay?

A. That is all; there is no calculated amount.

Q. 181. The calculation you refer to is merely multiplying the per cent by twenty to get the pounds per ton?

A. That is all.

Q. 182. Have you ever checked up the amount of oil which was supplied to the feed with the amount discharged in concentrate and in the tailings?

A. During the course of our operations at the plant I have frequently checked up those figures.

Q. 183. And how closely do they come, approximately?

A. Well, I have found that they would come very close to the amount of oil actually added and equal very closely, the amount of oil contained in the concentrate plus the tailing.

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Q. 184. Can you give us an example of a calculation of that kind?

A. Yes, I have made a calculation in the period from February 4th to 28th, which is the first period that contains the oil analysis on the concentrate and tailing. As will be seen by the report, there was during that period from February 4th to 28th inclusive, 20.07 pounds of oil actually added to the ore as it came to the flotation plant. That is equal in round numbers to one per cent, the amount of oil actually added then for this period based upon the tonnage of 36,262 dry tons, was 725,240 pounds of oil used during that period.

Q. 185. The tonnage was 36,262?

A. 36,262 dry tons.

Q. 186. Multiply that by your 20.07?

A. Yes. The amount of oil contained in the contrate plus the tailings was equal to 722,760 pounds.

Q. 187. Have you figured that percentage of error by deducting one from the other?

A. That is very easily done. That error is approximately three-tenths of one per cent.

Q. 188. Have you figured other periods to see if they come within the same order of accuracy?

A. Well, I figured the next period also.

Q. 189. And how close did that one come?

A. That came within practically one per cent.

Q. 190. And how close did they come?

A. They came within practically one per cent.

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Q. 191. That is the period from March 1st to 20th?

A. March 1 to 20, correct. I figured the next period and that came within approximately ten per cent, showing a variation. And the next period.

Q. 192. That is April 1 to 15, the next one?

A. Yes. The next period showed about fourteen per cent approximately. If you wish, I can figure out the exact amount, but that is approximately given from the figures. And, for instance, I have the last period April 1 to 15, that being 578,290 pounds or as against 502,850 pounds contained in the tailings plus the concentrate.

Q. 193. Was there any reason for that increase of error in these last two periods?

A. There was no reason that I know of, no.

Q. 194. I do not see the year 1917 on this left hand column here under the head "period." We have 1916, three quarters, that year, and then December 22nd to January 7th. I suppose that is where 1917 begins, that period extends over from 1916 over into 1917?

A. Yes, sir.

Q. 195. The years are not separated then, are they?

A. No, the third quarter of 1916 is on there separate from the year 1916 on account of having started a portion of the flotation plant during the month of December, 1916.

MR. WILLIAMS: Mr. Scott, I suggest that on

the exhibit in evidence you add dash and sixteen after December 22nd, and a dash or inclined line and 17 after January 7th. I have made that change.

MR. SCOTT: That will read then December 22nd, 1916 to January 7th, 1917. Will you consent? I will simply change it.

MR. WILLIAMS: I have changed it. I have the exhibit.

Q. 196. MR. SCOTT: Taking the three entries beginning with the one for the year 1913, that is the fifty horizontal line, up to the year 1914 and 1915, that is the entries for these three years, I find that the gain of the concentrate improves somewhat, 47.8 for 1913, 53.03 for 1914 and 54.82 for 1915. Can you state the causes that led to this improvement?

A. Well, the chief causes were the improvements in the plant and the operation and the mechanical changes that were made, changes in the flow sheet and also the change in mechanical conditions whereby our operating conditions were made better.

Q. 197. I don't suppose you remember in detail all of these changes? Do you remember any of them?

A. Well, in May, 1913, as I think I stated before the plant was down for a period of six days during which time a complete remodeling of the flotation machines occurred. Then during the third quarter of 1913 more changes were made, and also in the fourth quatrer of 1913 more changes were made, and during the year 1914 at various intervals changes

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were made in the flotation plant that entirely improved results—for instance, in 1913, speaking of the second quarter, we had four spitzkastens. Later on another spitzkasten on each rougher was added and continued that way until we had ten spitzkastens for each rougher. Then an additional cleaner was added—I may have a record of that right here, of the exact date. It was started rather late in 1913, a new cleaner was started in November, which provides for two cleanings instead of one previous to that time. Then in 1914 general mechanical changes throughout the flotation plant and the disposition of the feed and so forth between one cell and another was instituted and five additional spitzkastens on each one of the roughers and later on the change from five passes to seven passes, which means that the feed has seven different agitations throughout its course through the machine. Then in 1914, the latter part of 1914 we started installing again another type of machine which was the Janney machine, and started the first unit in 1915, during the month of January, and the whole plant was in operation by May 1st, 1915. So that accounts particularly for the improved results in the grade of concentrate as well as the recovery for the period from January, 1913, through and including December, 1915.

Q. 198. I notice in the period March 1st to 20th, 1917, the third line from the bottom, that the tailings ran 1.54 zinc, and the apparent recovery was 90.84, concentrates, 47.50. Will you point out on this table the earliest date when a result equal to that was ob-

tained—equal in efficiency, taking into account the grade of the concentrates and the recovery.

A. Well, the period that I should say nearly approximates it is the year 1915, when the recovery was 90.18%.

Q. 199. That was substantially the same order of recovery?

A. Also the grade of concentrate was higher during the period of 1915 than during the period of March 1st to 20th, 1917.

Q. 200. How about the loss in the tailings?

A. The loss in the tailings was of the same character during the period of 1915 as compared with the period of March 1st to 20th, 1917; I think that is the period which more closely corresponds.

Q. 201. Now we have here recorded 1913, 1914 and 1915. So that would be the third year of operations recorded on this sheet?

A. Yes, sir.

Q. 202. When the results you say were comparable with those obtained from March 1st to 20th. Now, from March 1st to 20th you were using how much oil?

A. The actual oil added to the ore going through the flotation plant was 21.3 pounds per ton.

Q. 203. During the year 1915 it was 1.49, was it not?

A. 1.49 per ton.

Q. 204. Now I see on this sheet it is recorded the amount of oil added per ton of ore. Do those figures represent the total amount of oil present?

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A. No, the total amount of oil present is much larger than that designated under the column "Per ton Ore to Flotation, Pounds." As shown by the figures in the column preceding it, "Pounds Oil Per Ton Contained in Ore and Circulating Middlings treated in flotation."

Q. 205. As I understand what you have stated, under the heading "Oil Pounds," those figures are the actual weight of oil added?

A. Absolutely.

Q. 206. Determined by actually weighing and by actually sampling and estimating the tonnage of ore going through the plant?

A. Yes.

Q. 207. And that figure giving the percentage of oil in the ore in the circulating middlings is the result of an assay of the amount of oil in the material going through these flotation machines?

A. Exactly so.

Q. 208. So there is no calculation about any of these figures; they are all determined by weight and measure?

A. Yes.

Q. 209. And then, according to these figures, will you just make a comparison between the amount of oil added for each of these periods and the amount found to be present by assay, using the figures per ton as they seem to compare?

A. During the period from February 4th to 28th in-

clusive, there was 20.07 pounds of oil added to the feed to the flotation plant, and 25.4 lbs. of oil present in the feed to the flotation machine.

Q. 210. And it was during that period that you just said the figures checked up within about 1%?

A. They checked up less than 1%. In the next period, from March 1st to 20th inclusive, there was added to the ore going to the flotation plant 21.3 lbs. of oil per ton, while there was in the flotation feed—

Q. 211. Including the middlings?

A. —to the machines, which includes the middlings, 30 lbs. of oil per ton.

Q. 212. During that period how close did you say the assays checked with the oil added?

A. About 1%.

Q. 213. Have you any explanation of the fact that during that first period, February 4th to 28th, the oil added was 20.07 lbs., and the oil present by assay 25.4, showing an increase of about 5 lbs. of oil, or a little over, while during this next period, March 1st to 20th, the difference between the oil added and the oil present as assayed is the difference between 21.3 and 30, or about 8.7 lbs.?

A. Well, my opinion now would be that it was due entirely to the operations. There was possibly more oil contained in the feed at different times that was sent back for circulation, and the mechanical conditions that existed, as I remember it, during that time, were somewhat erratic, and we were remodeling

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the plant also at that time, and there was not a great length of time wherein the actual operating conditions were the best, and where the feed that was returned, or the middling that was returned was always uniform, but it averaged up pretty well. Some days we would make it higher than others. That may account for it.

Q. 214. Do you vary the number of cells in a series that return the concentrate as middlings, or do you run pretty steadily?

A. At times we vary that, depending on the material we are treating, and in order to relieve our elevators, should anything go wrong with them.

Q. 215. The machines are fixed so you can switch them from middlings to rougher concentrates?

A. Yes, they are.

Q. 216. What is your information as to the relation of tonnage returned as middlings and tonnage originally sent to the flotation machine; is as much material returned as middlings in circulation as is fed to the machine? That could hardly be, could it?

A. Yes; and at times there is more middlings than there is actually fed to the flotation plant.

Q. 217. More circulating load than the original supply?

A. Yes, but in circulating the middlings in our plant it joins the original feed and is elevated by a 36 inch elevator, and then distributed to the machines, consequently we have no distinct circuit of middlings and original ore remaining.

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Q. 218. I think there you have daily records arranged by months for several months. The January record begins on the 9th; how is it that it does not begin on the first?

A. The reason for that is that on that day we commenced operations using more than 1%, or 20 lbs. of oil per ton of material.

Q. 219. And you began your daily compilation from the time the large amount of oil was used in the whole plant?

A. Yes,. sir.

MR. SCOTT: I offer in evidence tabulation of daily results for the month of January, 1917.

Admitted in evidence without objection, marked DEFENDANT'S EXHIBIT No. 159.

Q. 220. Now, in this tabulation I find the heading "Flotation Machine to Date; Ore Flotation Plant Plus Circulating Middlings Treated in Flotation." The samples for those assays I suppose is taken between the sluge tank and the head of the machine, is it?

A. That sample is taken just before the feed is distributed to the various machines; it contains the original ore and the circulating middlings.

Q. 221. Now, take the column headed "Percent of Oil in Ore and Circulating Middlings Treated in Flotation;" that is determined by a correct assay of the material I presume?

A. It is.

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Q. 222. The same as in the case of the other tabulations?

A. Yes.

Q. 223. The next is simply computed from the percentage?

A. Yes.

Q. 224. You have a column here also, "Oil Used," with a series of numbers. Have you a key for those numbers which explains what the oil mixture is?

A. Yes, I run all my oil mixtures by numbers.

Q. 225. Does the key run through for the days on which the statement for January is made?

A. Yes.

Q. 226. It runs all through?

A. All through.

MR. SCOTT: I offer paper headed "Butte & Superior Mining Company," with the notation below, "Statement of Percentage of Oils etc."

Admitted in evidence without objection marked DEFENDANT'S EXHIBIT No. 160.

Q. 227. You may explain the terms noted at the heads of the columns of oils there. What kerosene is that?

A. Commercial kerosene.

Q. 228. And the Jones crude?

A. That is Jones crude from Kansas; it is commercially called Jones crude.

Q. 229. The No. 1 creosote?

A. That is a hardwood creosote.

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Q. 230. The No. 2 creosote?

A. That is also a hardwood creosote.

Q. 231. Fuel, I suppose that means fuel oil?

A. Fuel oil from a petroleum base.

Q. 232. Pine oil next, No. 4 Barrett? What is that?

A. That is a coal tar distillate.

Q. 233. What kind of tar?

A. Coal tar.

Q. 234. Paraffine base; what does that mean?

A. Crude paraffine base oil.

Q. 235. Now, I believe you have similar statements for February and March, giving the particulars for each day?

A. I have.

Q. 236. And the testimony you have just given regarding the explanation of these headings, and regarding your supervision of operations applies to these operations recorded in February and March?

A. Substantially so, yes.

MR. SCOTT: I offer these statements in evidence for the months of February and March, 1917.

> Admitted without objection, statement for February marked DEFENDANT'S EXHIBIT No. 161, statement for March marked DEFENDANT'S EXHIBIT No. 162.

Q. 237. I notice Mr. Dosenbach, that in January the average amount of oil added per day was 14.75, appearing at the bottom of the column in the average line.

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A. Yes, it is.

Q. 238. And that in February the amount of oil added per ton averaged 19.33?

A. Correct.

Q. 239. Then considerable more was added in February than in January?

A. That is so.

Q. 240. Now, looking at the column "Pounds Oil Per Ton Contained in Ore and Circulating Middling Treated in Flotation," which I understand is determined by assay, for February it averaged 23.6 and for January averaged 33.4. Why did the oil present exceed the amount added so much more in January than in February?

A. Well, as I stated before, that may be accounted for in the operation of the machines themselves, and also in the character of the oil that was used. Now, as will be noticed in the last column here, under oil used, and the number, you will note that various mixtures were used, and almost every day they were changed, consequently the difference in the character of the oils themselves may account for some of that variation between the two months.

Q. 241. Now, I believe you have operated a part of the flotation apparatus separate from the remainder for some periods of time. Have you a statement setting forth the operations of that segregated unit?

A. Yes, sir.

(Recess.)

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Q. 242. You stated that you had a sheet recording the operations of this independent unit, didn't you?

A. I have.

Q. 243. And I find attached to my copy a paper headed "Butte & Superior Mining Company" with the statement: "Below is a statement showing the percent age of oils in the various mixtures, used on the three pyramid machines, while running them on experimental tests," and I presume that bears the same relation to these separate machines that the other oil sheet did to the regular operations of the mill?

A. It does bear the same relation.

Q. 244. These experiments were conducted, were they, or these special operations by you or under your supervision?

A. They were.

MR. SCOTT: I offer in evidence the tabulated statement headed "Butte & Superior Mining Company, flotation pyramid machines."

Tabulation admitted in evidence and marked DEFENDANT'S EXHIBIT 163.

MR. SCOTT: And I wish now to offer in evidence what I will call the oil sheet, headed "Butte & Superior Mining Company," "Below is a statement showing the percentages of oils in the various mixtures, used on the three pyramid machines, while running them on experimental tests."

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Document admitted in evidence and marked DEFENDANT'S EXHIBIT 164.

Q. 245. What was the purpose of separately operating this section of the plant?

A. The main purpose and chief purpose was the fact that we didn't have sufficient oil to operate the entire plant.

Q. 246. With the quantities and kinds of oil you wanted to use?

A. Yes, over one per cent or twenty pounds.

Q. 247. And what was the difficulty in getting a sufficient supply of these different oils?

A. Well, we had considerable difficulty in getting them on account of railroad facilities, it was impossible to get it here any sooner than on the 9th of January.

Q. 248. Was there any difficulty aside from the transportation difficulty?

A. Yes, one of the main difficulties was getting the oil.

Q. 249. Getting the oil?

A. Yes, being able to get it.

Q. 250. You mean there was not a supply available to be purchased?

A. Yes.

Q. 251. You might describe briefly what this separate section of the plant consists of, and in a general way how it was operated?

A. Well, this sheet or report sets forth the operations of an independent pyramid machine. There is a

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column where this machine number is shown and under it is the number of the machine that was in operation.

Q. 252. Now, when you say "pyramid machine" just what do you mean to designate by the word "pyramid"?

A. Well, the word pyramid is taken from the machine itself, it being a pyramid shape.

Q. 253. Simply similar to several of these machines of this Janney type, and each one higher than the preceding one, so that you have a gravity flow from one to another?

A. Exactly so, yes.

Q. 254. That is all that is meant by the word "pyramid?"

A. Yes.

Q. 255. And that is the regular arrangement of the entire plant, isn't it, that gravity or pyramid arrangement?

A. That is.

Q. 256. Now, under the column "machine number" on that first day, appears the figure "2." That is the number of the single machine or cell or the number of the whole set of these machines that are arranged one above the other?

A. That is pyramid No. 2 which consists of seven of the cells.

Q. 257. And each of these so-called pyramid machines consist of seven cells?

A. Exactly so.

Q. 258. And then each of these numbers in the col-

lumn "machine No." indicates some particular group of seven machines that is being used for this test here recorded?

A. Yes, sir, it does.

Q. 259. So that all the tests were conducted on a machine consisting of seven Janney cells?

A. They were.

Q. 260. And they were these cells of the double spitzkasten type, weren't they?

A. They were.

Q. 261. Now, is there anything in these column headings that is different from the phraseology that you explained in conection with the other report?

A. Well, the first column, "machine feed," with the "ore to machines," that consists of a portion of the slime and a portion of the tube mill discharge.

Q. 262. Where do these slimes come from?

A. The slimes were regularly produced at the plant.

Q. 263. From the gravity concentration?

A. Gravity concentration end of the mill, and the tube mill product is the finely ground material that is produced in the mill itself or the concentrating end of the mill and is ground to sufficient size to go to flotation. It is sand tailing from the concentration end of the mill.

Q. 264. Now, in this column "machine feed" "ore to machines," "per cent zinc recovery," that percentage of zinc was obtained by assay, was it not, of the material fed, in this report?

Ben H. Dosenbach.

A. Yes, in this report, it was.

Q. 265. And so of course is true of the percentage of zinc in concentrate and headings, is it not?

A. It is. The apparent recovery is given but not the estimated recovery on account of not being able to obtain any definite weights or measurements of the concentrate produced.

Q. 266. That was because the concentrates were mixed up with the concentrates from the rest of the mill?

A. Yes, the concentrate produced in these machines was mixed with the regular concentrate.

Q. 267. And this "estimated recovery" is taken from actual weight?

A. It is.

Q. 268. Now under the general heading, "oil amount and analysis" we have a column "% oil in ore and circulating middling treated in machines." I presume that is obtained by assay from samples?

A. That is obtained by assay from samples taken.

Q. 269. After the—

A. (Interrupting.) Middling has been added to the original feed.

Q. 270. Yes, after they both come together?

A. Yes.

Q. 271. The next column simply converts the percentage into pounds?

A. It does.

Q. 272. "Per cent oil in concentrate" and "per cent oil in tailings" is found by what?

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A. By analysis.

Q. 273. The last column refers to the oil, kind?

A. Kind of oil used.

Q. 274. Now, is there a column here that tells how long these different operations lasted, or were they all for the same period?

A. They were for 24-hour periods on the days designated, and some days may have not been entirely 24 hours for the particular pyramid machine named if it was necessary at times to shut it down for repairs for an hour or two, possibly; but these are the actual results from these particular machines on these particular days and no other feed was put into that machine while it was not in operation on the material designated in this report.

Q. 275. The tonnages there give a pretty fair idea of the time that each operation was conducted, I suppose, dont' they?

A. Yes.

Q. 276. I see some of these tonnages run up as high as 240. That is probably a 24-hour run, would you say?

A. Yes, that was a 24-hour run, I should say, judging from the tonnage.

Q. 277. Now, what was the largest percentage of oil used in any of these operations—we will take on the basis of pounds of oil added, say, rather than on the basis of the analysis?

A. I find in this report that on the first day of January, 1917, there was 63.03 pounds of oil added.

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Q. 278. Yes. Now, running over the column "pounds oil per ton in ore and circulating middling treated in machine" I find 55.8 pounds of oil per ton. That figure is somewhat lower than the amount of oil per ton of original feed added. What would that indicate in regard to the amount of oil on the middling?

A. That would indicate that there was less oil in the middling being returned.

Q. 279. Less than 63.03 pounds?

A. Yes, and that the returned middlings contained a lower percentage of oil than say on—other days. There are a number—there are a few days like that in the other reports, in the monthly report by days, that show that same thing.

Q. 280. What were your recoveries and grade of concentrate and loss of zinc in tailings on that day, January 1, 1917, when you used 63.3 pounds of oil per ton?

A. The recovery was 91.72 per cent, and the grade of concentrate produced was 42.7 per cent.

Q. 281. And the tailings?

A. The tailings contained 1.51 per cent zinc.

Q. 282. Now, were the concentrates from that tailing marketed?

A. They were.

Q. 283. What would you say as to the recovery of zinc—as to the loss of zinc in the tailings and the recovery, as to their efficiency? That is 1.51, is that a good or a bad operation?

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A. That is a good operation showing a recovery of over 91 per cent.

Q. 284. Now, do any of these other assays bring out any matters of interest that you wish to comment on?

A. Well, I should say, selecting one above that, on the first day of January, 1917, on a different pyramid machine, #2 pyramid, the tailings assayed .5 per cent zinc, one-half of one per cent, making a recovery of 97.18 per cent zinc, showing a concentrate of 44.6 per cent zinc. I may add also here that the pyramid machines in operation as reported on this report consist of six cells and not seven, as the first cell was used as a cleaner.

Q. 285. What effect would that have on the operation?

A. Well, that would give six different agitations instead of seven, also six spitzkastens from which the froth was taken off, or twelve instead of fourteen, counting the double spitzkasten, or seven, counting the single spitzkasten, and also shows that there was only one cleaning operation of the concentrate that was produced by the rougher cell or the rougher pyramid consisting of six cells.

Q. 286. Did the concentrate from these specially operated pyramid machines have any further treatment?

A. They did not; they had no further treatment than the cells themselves, as far as these assays were concerned.

Q. 287. As far as the assays were concerned?

A. Yes.

Q. 288. That is these operating assays that are here are from samples taken just when the concentrate left the pyramid machine?

A. Yes.

Q. 289. Now, what became of these tailings after they left the pyramid machine?

A. They went through the air cells down below, but they were mixed up with the tailings that were produced in other portions of the plant so consequently no assay could be determined after they left the air machine.

Q. 290. You didn't have any special air machine coupled up to this machine?

A. No.

Q. 291. About these other reports of general operations that you have testified about, are the tailing assays there made from tailings after they have gone through these air machines?

A. They were.

Q. 292. But in the case of these operations recorded on these special pyramids, the assay of tailings merely represents the tailings made by that pyramid?

A. Exactly so, yes.

Q. 292½. MR. SCOTT: I think that will be all unless you find something here that requires explanation, Mr. Dosenbach?

A. There is one thing I would like to explain about. In the January report by days for 1917, and that is on the 31st the apparent recovery was 87.12.

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Q. 293. What day was that?

A. On the 31st of January.

MR. WILLIAMS: Exhibit 159?

A. Yes.

MR. SCOTT: The apparent recovery you said was 87.12?

A. And the estimated recovery was 130.70. I think it would be well to enlighten you on that particular date. Now, that is due to being the last day of the month and for our general reports and our general method in use, on the last day we take a general summary of what our products has been for the month as compared to each day's measurements, and consequently it shows an under estimating for 20—or the number of days previous to the 31st. Now, in addition to that, on account of not having sufficient railroad cars to transport our concentrates it was necessary to stack quite a lot of our concentrate on our grounds or bins provided for that purpose, after they had gone through the filter plant, and so some of this material was not taken into consideration in each day's calculation, or each day's measurement. Consequently, it was necessary for a general cleanup of the month to take into actual account all of the products for that month, and we had to take it into consideration on the last day. So that makes the difference between the estimated—or accounts for the difference between the estimated and apparent for the 31st of January.

Q. 294. That is this estimated recovery is figured

from the absolute weights of the concentrates, and their assay?

A. From the estimated weight and assay, yes.

Q. 295. But some days that estimate was not based upon all the concentrates produced, and they accumulated during the month?

A. Yes.

Q. 296. So that the 31st day of the month got credit for some of the concentrates that had been produced previously?

A. Yes.

Q. 297. And to be absolutely accurate now I understand that some of this excess over one hundred per cent there or some of this excess should be distributed through all of these days, but that it is impossible to do it?

A. That is it exactly.

Q. 298. So that some of these estimated recoveries here are under statements, up to the 30th of the month?

A. Yes, it is more of a direct comparison, one day with another by the apparent recovery, but over a period of a number of days the estimated recovery should approximately check very closely with the apparent recovery.

Q. 299. The average for a considerable period would come close together?

A. Yes.

Q. 300. But on account of this accumulation of material why you couldn't figure out a comparison between individual days?

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A. Yes.

MR. SCOTT: I think you may cross-examine.

MR. WILLIAMS: Before commencing cross-examination I would like to say that we have been presented with tables of a number of experimental operations and have not had time to give them study and I would like to reserve the right to object to these experimental operations until we have had a chance to study them, being inclined to let them in if on further study we think they may be material.

Q. 301. MR. SCOTT: Mr. Dosenbach, these operations in this special pyramid machine, they were real, mill sized operations, weren't they?

A. Absolutely so.

Q. 302. They all entered into the product of the mill, which was marketed?

A. Yes, sir.

Q. 303. The only difference being that this part was separated for special operations?

A. As an indepndent and isolated circuit from the rest of the plant, but treating the same material as the rest of the plant did treat.

Q. 304. The concentrates were sold the same as all the rest of the mill?

A. Yes.

Q. 305. But it enabled you to keep track of the results without getting them all mixed up with the regular mill results?

A. Exactly so, yes.

Ben H. Dosenbach.

CROSS-EXAMINATION.

BY MR. WILLIAMS:

X-Q. 306. Referring particularly to this table, exhibit 163. Now, "concentrates, percentage zinc," that was determined upon the concentrates after they had been delivered by the cleaner machine?

A. By the one cleaner machine which was on the pyramid that it represents.

X-Q. 307. You say the first machine was the cleaner machine?

A. Yes, sir.

X-Q. 308. By that do you mean the upper machine of the pyramid?

A. The first cell of that particular pyramid was the cleaner machine.

X-Q. 309. And that was the highest machine of the three?

A. Yes, sir.

X-Q. 310. So that the rougher concentrates from the other six machines were carried by an elevator, were they not?

A. No, by a pump.

X-Q. 311. By a pump?

A. Pump, centrifugal pump. It was necessary to pump it back up to this first cell. The original feed came into the second cell while the rougher concentrates were made on the first two cells and the middling on the next four; or it was so arranged that the next three

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could make a rougher concentrate or middling, either one and that rougher concentrate was pumped back again to this first cell.

MR. SCOTT: At this point, if I may interrupt, I would like to offer that in evidence so that it can have a number, and the record wil show what you are referring to.

Diagram admitted in evidence and marked DEFENDANT'S EXHIBIT 165.

X-Q. 312. MR. WILLIAMS: That is the flow sheet that was produced and described on Saturday last? Is that right, Mr. Scott?

MR. SCOTT: Yes.

THE WITNESS: Yes, that is the flow sheet that I produced and described on Saturday. However, I will produce another flow sheet to show exactly as the materials are going today. That doesn't show everything complete, but for this reference we can use.

X-Q. 313. Now, I want to understand exactly the opeartions during these runs that are tabulated in Exhibit 163, and as I understand now on machines 2 and 3, you produce a finished concentrate?

A. Now, let me correct you on that. This is machine No. 1, and at that time this was machine No. 2, and at that time this was machine No. 8.

X-Q. 314. As you have marked them in pencil?

A. Yes. Now the machines are numbered 1, 2, 3, 4, 5, 6, 7, 8 as I indicate, consequently the machine which is now marked No. 5 was at that time marked No. 2.

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X-Q. 315. Now, cell No. 2 and cell No. 3 of that complete pyramid machine produced a finished concentrate?

A. They produced a rougher concentrate.

X-Q. 316. And cells No. 4, 5, 6 and 7, what do they produce?

A. They produce a middling product.

X-Q. 317. What became of the middling product?

A. The middling product was pumped back to cell No. 2.

X-Q. 318. And the rougher concentrate was pumped where?

A. To cell No. 1.

X-Q. 319. And from cell No. 1, then was delivered only finished concentrate?

A. Exactly so. The cleaner concentrates from cell No. 1 ran by gravity into cell No. 2. That is why we used cell No. 2, because we did not have to pump these cleaner tailings, because it ran by gravity into cell No. 2. That is the first cell handling original feed plus the middlings. The final tailings are made only by cell No. 7.

X-Q. 320. I think now we have it all. The only final tailings are made by cell No. 7?

A. Yes.

X-Q. 321. And the only final concentrates are made by cell No. 1?

A. Exactly so.

X-Q. 322. Your final concentrates from cell No. 1

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are assayed, and your assays are based on that concentrate as delivered?

A. Exactly so.

X-Q. 323. And the tailings also are from those tailings as delivered from machine No. 7?

A. From cell No. 7, yes sir.

X-Q. 324. And that aplies to every one of these operations described in exhibit 163, is that correct?

A. That is correct.

X-Q. 325. When did you commence work at the flotation plant of the Butte & Superior Mining Company?

A. About the first of May or thereabouts; it was in May, 1913.

X-Q. 326. What kind of flotation machines were in ues then?

A. The ordinary agitation and spitz box type, built entirely of wood.

X-Q. 327. Were they substantially the same as the standard mineral separation plants?

A. What is the standard mineral separation plants?

X-Q. 328. We have in evidence on pages 1030 and 1031 of the record in the Hyde suit, a drawing entitled "Complainant's Exhibit, King John's Court, Standard Plant." There is also on page 27 a cross section of that plant. Please look at those drawings and say whether or not they fairly in general represent the type of machine that was in use when you went to work for the Butte & Superior.

MR. KREMER: Do you refer to the record in this court or in the Circuit Court of Appeals?

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MR. WILLIAMS: To the record in this court, which is already in evidence.

A. No, I see quite a little difference to this which is represented here by the King John's Court Standard plant, and what was in use at that time at the Butte & Superior plant.

X-Q. 329. Are there any resemblances?

A. Yes, there is a resemblance, as there are spitz boxes and agitating cells in this drawing, and there were also spitz boxes and agitating cells in the plant of the Butte & Superior at that time.

X-Q. 330. And in addition ~~to~~ in the agitating cells was there a rotating agitator having blades located near the bottom of the cell?

A. There was.

X-Q. 331. And the pulp that was agitated in the agitating cell flowed into the spitzkasten?

A. It did.

X-Q. 332. And the froth from the spitzkasten overflowed? A. It did

X-Q. 333. And the tailings went where?

A. The tailings were elevated to the next agitating cell.

X-Q. 334. Where—Were these machines known by any name?

A. I knew of them by no name at that time.

X-Q. 335. You did not know them as the Hyde machines?

A. Absolutely not. I didn't know Hyde at that time.

X-Q. 336. Have you any drawing that you can pro-

duce showing these machines as they were then installed?

A. I can make one for you.

X-Q. 337. Will you do that later on and let me have it?

A. All right.

X-Q. 338. I note that for the first quarter of 1913 the apparent recovery of zinc was 65.34 and that for the second quarter of 1913 that same item was 85.71. That appears on exhibit 158.

A. You are correct.

X-Q. 339. Can you explain why that great difference existed betwen the recoveries?

A. On April 25th the flotation plant was shut down for remodeling and changing over into a new system, which resulted in very much better recoveries after it was started up again—about a week or so later. You might say still that it might be due to the more oil being added; there was twice as much added during the second quarter as during the first quarter but I think it is due to the mechanical changes that were made which resulted in better operating conditions throughout in general.

MR. WILLIAMS: I will ask of counsel of the defendant whether they will produce a witness who is familiar with the operations during that first quarter, in view of the fact that they seem to have been most disastrous operations, and this witness can not tell anything about them except from the record.

Ben H. Dosenbach.

MR. SCOTT: We will furnish a witness, or two or three of them.

A. I was not present during that time.

X-Q. 340. Well, I won't ask you about it. Now, covering the period of your experience, when was the next shut down for alterations?

A. Well, the shut downs came pretty frequent about then.

X-Q. 341. Just run over them. Have you a record of them?

A. I have a partial record of them, and I find that during May of 1913 we did quite a lot of experimenting.

X-Q. 342. What did you do in May; how many times did you shut down?

A. Well, I haven't that all here; I cannot tell you that; but the conditions, the mechanical conditions were such that it was necessary to shut down quite often to fix up the plant. We changed in 1914 from the method of handling the material from one spitz to the agitating cell, and put in pumps instead of air lifts, and in the second quarter we changed and added more additional spitzkastens, which assisted in recovering, and later changed to pumps on No. 2 roughers, having changed on No. 1 before. Then during the third quarter and last quarter of 1914 the arrangement of the flow through the cells was changed, so that, instead of making five passes, as you might call them, or having five cells, we had seven. So then, in the last of 1914 we started to excavate for the new Janney machines, and

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during the first quarter of 1915 these Janney machines were being installed, one by one.

X-Q. 343. And that was the first installation of Janney machines at your plant?

A. Yes; and during the second and third quarter the Janney machines were completed, and the old machines were torn out.

X-Q. 344. Were those the pyramid Janney machines that you have now?

A. No. Now, then, again, those Janney machines were torn out and the pyramid type put in. That was due principally to the original Janney machines not operating well on account of the foundations. They were set upon concrete foundations, and the ground moved considerably up there, so that one machine was at an angle one way and the machine next to it was at an angle another way, and it was very nearly impossible to operate them; they had settled so much that they had to be entirely changed, and the pyramid was put in on wooden foundations, so that, if any more settling occurred, they could be brought back into shape again without having to tear up the whole plant and remodel.

X-Q. 345. When did you put in the pyramid machines that are now there?

A. We started putting in the pyramid machines during the latter part of 1916, was the first ones, and that was the No. 2, which is now the No. 5. That was the first one that went in, because we had no other machine in that particular part of our flotation plant at that

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time, and we could install that without interferring any with the operations of the other machines.

X-Q. 346. And then the other pyramid machines, when were they installed?

A. They were installed right along, following No. 2.

X-Q. 347. So that when did you have the complete pyramid plant installed and operating?

A. It was in February or March of 1917, I am not positive which, but I can give you the exact date by looking up the record.

X-Q. 348. Well, taking these records in Exhibit No. 158, do they enable you to fix the dates, or the time when the complete pyramid machine—pyramid plant was installed. You have divided it into periods.

A. Well, it was divided into periods on account of this report being kept up from time to time. This report was gotten out, and later on more material was added to it; that is, when we had a period of sufficient length of time to add to it. But it was not until some time in February or March that we started the entire plant, or that the entire plan was operating on the pyramid type machines. It was after we had started using 20 lbs. or more of oil per ton of ore on the entire plant.

X-Q. 349. Will you look up that date and let me have it?

A. I will.

X-Q. 350. What is the reason for dividing this report as to 1917 into periods?

A. Well, as I say, this report was gotten up in 1917,

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and was gotten up as far back as the first part of March, showing the results as they existed in this report at that time. Then, after the 20th, this report was gotten out, showing the same material, but for the additional 10 days in March, and the 21st to the 31st and the first to the 15th, which was not on the original report.

X-Q. 351. Taking the first period, December 22nd to January 7th, as to which you have supplied no details, why did you link that as a single period?

A. Up to that time we were operating the pyramid machines on more than 1% of oil and the rest of the plant on less than 1% of oil, and after that time the entire plant was started on more than 1% of oil.

X-Q. 352. Then during that period from December 22nd to January 7th you were operating a part of the plant on less than 1% of oil, but you do not include that in your report?

A. That is included in the third quarter of 1916. That is why the third quarter of 1916 is segregated from the average for the year 1916, on account of including from December 22nd to the 31st of December, when a part of the plant was in operation on more than 20 lbs.

X-Q. 353. Now, from January 1st to January 7th, the operations with less than 1% of oil are not included in the report, is that right?

A. They are not included.

X-Q. 354. When did you discontinue those operations with less than 1% of oil?

A. We discontinued them on—January 9th was the

first day that we operated the entire plant on more than 1%.

X-Q. 355. And from that time on were there any operations that were not shown in your report here?

A. There are no operations.

X-Q. 356. What happened between January 20th and February 3d, 1917; were they included in one period—I can't quite read that; was that the intention?

A. Yes, it was, but the exact amount of oil that was added during that period was 16 lbs., which is a little less than 20 lbs., and we had no oil analyses of the machine feed at that time, which consisted of the original ore and the circulating middlings in flotation.

X-Q. 357. Below that is that and the item, January 7th to February 6th, inclusive?

A. Yes.

X-Q. 358. Does that include a run?

A. No, that includes the entire period for that time.

X-Q. 359. Now that overlaps on February 4th to February 28th. Why are they overlapped?

A. Well, the correct oil analysis of the percent of oil in the ore and circulating middlings treated in flotation—we did not have it for that period entirely; that is the only reason that I know of why that is separated that way.

X-Q. 360. So that the overlapping in dates which appears in those two periods was an actual overlapping, but you took February 4th as the commencement of the period, because you had certain determinations for that period, is that right?

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A. Yes.

X-Q. 361. When did you commence to study the effect of larger quantities of oil than 1% in flotation concentration of ores?

A. I ran across that accidentally; I did not start to study that. That was in the summer of 1913, when I was sent to the Utah Copper to assist in determining what could be done down there with the flotation of their ores.

X-Q. 362. Did you perform any experiments in the San Francisco Court of Appeals at the hearing in the Hyde case?

A. I did.

X-Q. 363. What time was that?

A. I will have to look up the exact time on that.

MR. SCOTT: It was February, 1914.

X-Q. 364. It was February, 1914, I believe. And you say that you commenced to study the effects of larger quantities of oil at what time?

A. Well, as I said before, I was sent to Utah in July, 1913, and while down there I was endeavoring to see what could be done on the Utah Copper ore, and while investigating the possibilities of flotation at that time, as far as I knew of it, I found that in order to get results there, it was necessary to use quite a large quantity of coal tar or coal tar derivatives.

X-Q. 365. Now, you are talking about experiments, aren't you?

A. Oh, yes.

X-Q. 366. You performed experiments in this court

on the hearing of the motion for a preliminary injunction, did you not?

A. I assisted in those experiments, yes.

X-Q. 367. And then you performed experiments at Wilmington, Delaware, at the trial of the Miami case, did you not?

A. I did.

X-Q. 368. And in the Supreme Court of the United States at the hearing of the Hyde case?

A. I did.

X-Q. 369. And in the hearing at Philadelphia in the appeal of the Miami case?

A. I did.

X-Q. 370. As I remember it, in the Miami case I asked you about how many experimental operations you had performed with large quantities of oil, and you gave me an estimate then of about a thousand; what is the present estimate?

A. Well, I don't know how I could estimate that. That is my general duty, to perform experiments and to investigate the possibilities of the various ores and oils, especially oils, and as there are many kinds of oils, why naturally the number of experiments that I have performed would run into a great number.

X-Q. 371. Now, you performed an experiment in court with a machine alleged to be the machine described in the Criley Everson publication. Is that the same machine that was used in Wilmington, Delaware, in the trial of the Miami case?

A. It is not the same machine.

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X-Q. 372. Is anything about it the same machine?

A. Substantially so, yes; it is similar to the one that was used there.

X-Q. 373. Well, is there anything about it the same machine?

A. No.

X-Q. 374. Is it a new machine?

A. It is not the same machine at all that was used there.

X-Q. 375. It is a new machine, and it is different from what the machine was there, is that right or is it the same in construction?

A. It is substantially the same in construction as the one that was used in the Miami case.

X-Q. 376. What differences have you made in the details of the construction in making this new Fryer Hill machine?

A. I have made no intentional differences whatever. There may be something slightly different in the construction, but it can not be the same machine, because the other machine is still in court.

THE COURT: You asked once about the Criley Everson and then about the Fryer Hill; are they both the same?

MR. WILLIAMS: I made a mistake. The Fryer Hill.

X-Q. 377. As you described this old Fryer Hill machine, you said the central tube was hollow, and there was an opening, I believe, at the bottom of the tube, just above the cross blade agitators?

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A. Yes.

X-Q. 378. What function did that hollow tube and that opening perform in the operation that was carried on in court?

A. It performed no function whatsoever.

X-Q. 379. As I look at it now, there are two holes at the place indicated, diametrically opposite, and they are both of them nearly stopped up; do you agree as to that?

A. I haven't looked at it; I will inspect it and see. Yes, they are partly stopped up.

X-Q. 380. When you rotated that cross blade agitator, in what manner did the inclined vanes on the bottom of that agitator operate, to throw the material outward or inward?

A. Outward.

X-Q. 381. You performed an experiment which concluded with an upcast séparation of the metalliferous mineral, which sank against the upcast, and you said that roughly speaking the percentage of oil to metalliferous mineral was about 7%; is that right?

A. It is.

X-Q. 382. Can you give me the metalliferous mineral content of the ore that you used, having in mind that it contained not only blende but some other metalliferous mineral?

A. Well, I would have to have that analyzed before I could give it to you. I only paid attention to the zinc content, and based my figures upon the actual zinc and zinc sulphide content. However, I will

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give it to you approximately from my own knowledge of how the ores run.

X-Q. 383. Well, you may give it approximately and correct it later if you are in error.

A. I will look it up and give it to you exactly.

X-Q. 384. Well, then, give it to me exactly. Does the insoluble, as given in the assay, give you a figure which, if subtracted from the total, will give as the difference the metalliferous mineral?

A. I gave no insoluble assay.

X-Q. 385. Well, is that so; that is, usually is that a fact?

A. It will give you very close to the amount of sulphide which is contained, which can be added to the amount of metal as determined.

X-Q. 386. You said that you were familiar with the Everson patent, and that you find in the Everson patent authority for the use of sulphuric acid and copper sulphate together?

A. I did.

X-Q. 387. Please point out in the Everson patent the part thereof which is authority for your statement about this, and read the part you refer to.

A. On page 1 of the Everson patent, line 87: "The acids which I have employed are sulphuric, hydrochlori~~de~~c, nitric, phosphoric, acetic, oxalic, tannic and gallic. I have also used the following salts, to-wit: the sulphates and chlorides of sodium, zinc and copper, and the double sulphate of potash and alumina." "The selection of the appropriate agents, will however, be

largely determined in the practical working of my invention by the consideration of economy, which will obviously exclude the greater number of those above enumerated."

X-Q. 388. When did your knowledge of mining operations commence, or metallurgical operations?

A. Just what do you mean, a little more fully; I don't quite understand.

X-Q. 389. Well, when did you first commence to study or practice metallurgy?

A. In 1906.

X-Q. 390. While you were performing an alleged Fryer Hill experiment, I called your attention to the fact that the description of the ore in that experiment was as follows: "The ore was first crushed and rolled to such a degree of fineness as to enable it to pass through a forty mesh screen?" And then I asked you about the ~~mineral~~ material that you were using in that experiment. Now, in the first place give me the screen analysis of that material?

A. I can't give you a screen analysis of that material, but I can give you a screen analysis of some of the same materials, of which I have made a screen analysis.

X-Q. 391. Which you believe will be substantially the same?

A. It will.

X-Q. 392. All right.

A. On a 65 mesh or plus 65 mesh, 2.21 per cent; +100 mesh, 8.03 per cent; +150 mesh, 9.24 per cent;

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+200 mesh, 19.48 per cent; ~~+~~-200 mesh, 61.04 per cent. That is approximately what the other would be.

X-Q. 393. Did it go any finer than that?

A. I have nothing finer than 200 mesh.

X-Q. 394. Will you, as a metallurgist, stand for the proposition that this material that you used is a material such as was described in the Fryer Hill publication?

A. I will. My reason for doing so is that the Fryer Hill publications stated that that ore was crushed and rolled to pass a 40 mesh screen; and anyone familiar with the operation of rolling, crushing will know that in order to crush the ore equal to a 40 mesh screen that there will be a great proportion of fines made on account of the method of feeding the rollers, which will be a choke feed, and there will consequently be a great amount of fines made.

X-Q. 395. Now, have you the record of the daily operations at the commencement of your work with the Butte & Superior Copper Company?

A. I haven't the daily record tabulated as I have done in 1917.

X-Q. 396. But you have a daily record which will give the information?

A. Yes.

X-Q. 397. In what form is it?

A. Why, I have the daily record in report form; that is in daily reports which include the assays of the headings, the mill—the general tailings, concen-

trates, flotation as produced by the mill and the amount of reagents used and the tonnage treated.

X-Q. 398. Well, will you let me see the record for the first months that you were there?

MR. WILLIAMS: While waiting I will hand up an affidavit of Mr. Ballot covering those matters in relation to the proposed supplemental bill of complaint which we were discussing.

A. It will be necessary for me to give you the date. The record for the first month I was there, I have got to go farther back than that because this report does not begin until the last of 1913.

X-Q. 399. MR. WILLIAMS: These are the earliest that you have?

A. Of this year. It will be necessary to go back and get the assay sheets, each individual one, and get the material from those.

X-Q. 400. Well, now, take the first day that you have a record of here?

A. All right.

X-Q. 401. What is that day?

A. November 1, 1913.

X-Q. 402. Now, this table that you have produced is the original record of the company, is it?

A. This one?

X-Q. 403. Yes, this table that you have here?

A. Yes.

X-Q. 404. That is the original record of the company and not a copy, it is a record of the company? Is that right?

Ben H. Dosenbach.

A. Yes, that is correct, yes.

X-Q. 405. And from it you have no tabulations wherein the days are brought together?

A. From it we have monthly statements, yes.

X-Q. 406. But no daily statements other than these?

A. Well, it don't include all the information that this does.

X-Q. 407. Well now, how many—what was the first item of that statement?

A. The first statement—the first item is ore received, dry tons for the day. The total to date, and the last of the month.

X-Q. 408. Well, for the day 1193 tons?

A. Yes.

X-Q. 409. And then what is the next heading or column giving tons, 1181?

A. That is the amount of ore that was milled for that particular day.

X-Q. 410. Now, give me the assay of concentrates produced on that day?

A. The zinc concentrate produced, dry tons, was 377.

X-Q. 411. Now, give me the zinc content of these concentrates?

A. 50.5.

X-Q. 412. And the amount of the tailing?

A. The zinc content of the tailings?

X-Q. 413. No, the amount of the tailings?

A. Well, I would have to calculate that first.

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X-Q. 414. Well then, never mind. The zinc content of the tailings?

A. 3.1 zinc.

X-Q. 415. Now, that figure as the zinc concentrate, is that the zinc concentrate of the flotation plant or the total zinc concentrate of the mill?

A. Below here we have the zinc concentrate, zinc content of the concentrate that was produced by the mill, then also by the flotation plant separately by shifts.

X-Q. 416. Will you give me that mill zinc concentrate on the first shift that day?

A. That was 52.8; the second shift 53.0, and for the third shift 52.3. The flotation concentrate for the first shift was 49.7; for the second shift 49.05 and for the third shift 49.6.

X-Q. 417. I notice a line giving the dilution of the flotation feed. I suppose that is the proportion of solids to water?

A. That is the proportion of the water to the solids, yes, sir.

X-Q. 418. Just give me that figure?

A. The first shift, 2.4; second shift 2.3; third shift 2.4.

X-Q. 419. Now, give me the amount of oil used, first, flotation oil pounds?

A. 1429 pounds the first day, which was equal to 1.209 pounds per ton.

X-Q. 420. And whose signature is signed to that sheet?

Ben H. Dosenbach.

A. F. R. Wicks, mill superintendent.

X-Q. 421. And that is the F. R. Wicks who has testified in this case, is it not?

A. That is the F. R. Wicks.

MR. GARRISON: I offer in evidence the following documents delivered by the defendant in response to our call, and ask that they each be admitted in evidence and marked with their appropriate number.

MR. KREMER: To each of the documents offered in evidence the defendant objects for the reason that it is incompetent, irrelevant and immaterial, and tends to prove no issue in the case and it is particularly incompetent insofar as the alleged issue of estoppel or res adjudicata is concerned in that no evidence has been introduced or offered which in its nature is of such a character as to constitute estoppel or res adjudicata as against this defendant; and for the further reason there is no sufficient issue of estoppel or res adjudicata raised by the pleadings.

THE COURT: These are part of the same matters to show payment?

MR. GARRISON: Yes, sir.

THE COURT: The same ruling. The objection will be overruled and exception will ~~not~~ be noted.

MR. KREMER: An exception should be noted to each of the exhibits.

WHEREUPON the following documents were admitted in evidence and marked with the respective exhibit numbers shown in connection with each.

Voucher No. 3409, amountng to $165.00 issued to

J. M. Hyde under date of July, 1911, admitted in evidence and marked DEFENDANT'S EXHIBIT 166.

Voucher of the Butte & Superior Copper Company No. 3495, amounting to $155.00, in favor of J. M. Hyde, August, 1911, admitted in evidence and marked DEFENDANT'S EXHIBIT 167.

Voucher No. 3508, amounting to $150.00 issued to J. M. Hyde under date of September, 1911, admitted in evidence and marked DEFENDANT'S EXHIBIT 168.

Voucher of Butte & Superior Copper Company No. 3519 amounting to $150.00, in favor of J. M. Hyde, September, 1911, admitted in evidence and marked DEFENDANT'S EXHIBIT 169.

Voucher of Butte & Superior Copper Company, No. 3584, amounting to $150.00, in favor of J. M. Hyde, under date of September, 1911, admitted in evidence and marked DEFENDANT'S EXHIBIT 170.

Voucher of Butte & Superior Copper Company, No. 3610, amounting to $5,000, in favor of J. M. Hyde, October, 1911, admitted in evidence and marked DEFENDANT'S EXHIBIT 171.

Voucher of Butte & Superior Copper Company, No. 3609, amounting to $130.00, in favor of J. M. Hyde, October, 1911, admitted in evidence and marked DEFENDANT'S EXHIBIT 172.

Voucher of Butte & Superior Copper Company, No. 3764, amounting to $230.15, in favor of James

M. Hyde, November, 1911, to which is attached a paper headed "Expense Account, Chicago Trip, J. M. Hyde," admitted in evidence and marked DEFENDANT'S EXHIBIT 173.

Voucher of Butte & Superior Copper Company, No. 4153, amounting to $369.47, in favor of J. M. Hyde, March, 1912, admitted in evidence and marked DEFENDANT'S EXHIBIT 174.

Voucher of Butte & Superior Copper Company, No. 4154 amounting to $400.00, in favor of J. M. Hyde, April, 1912, admitted in evidence and marked DEFENDANT'S EXHIBIT 175.

Check of Butte & Superior Copper Company, dated July 8, 1912, payable to the order of J. M. Hyde for $200.00, to which is attached voucher of the Butte & Superior Copper Company, No. 4550 for the same amount and bearing the same date, admitted in evidence and marked DEFENDANT'S EXHIBIT 176.

Check of the Butte & Superior Copper Company under date of November 21, 1912, payable to James M. Hyde, for $602.50, to which is attached two lead pencil memoranda and a letter on the letterhead of Hayden Stone & Company, Bankers, New York-Boston, bearing date New York, October 3, 1912, addressed to Mr. M. W. Atwater, Butte & Superior Copper Company, Butte, Montana, consisting of two pages, a typewritten sheet headed "Expense account of James M. Hyde, trip to Washington Patent Suit, leaving Butte, April 17th, 1912, amounting to $334.05,

another typewritten document headed "Expense account of James M. Hyde, Trip to London, on Patent Suit, leaving Butte, July 18th, 1912," amounting to $868.45, and voucher of the Butte & Superior Copper Company under date of November 21, 1912, payable to the order of James M. Hyde, No. 5333, amounting to $602.50, admitted in evidence and marked DEFENDANT'S EXHIBIT No. 177.

Letter on the letterhead of the Butte & Superior Copper Company, under date of July 31st, 1913, addressed to Mr. J. L. Bruce, Manager Butte & Superior Cop per Company, Limited, Butte, Montana, signed by N. B. MacKelvie, and a purported copy of letter bearing date Berkeley, California, July 30th, 1913, addressed to N. B. MacKelvie, signed James H. Hyde, admitted in evidence and marked DEFENDANT'S EXHIBIT 178.

WHEREUPON an adjournment was taken until 8:00 P. M. of this day, Monday, April 30th, 1917.

Prof. Arthur Fay Taggart.

8 o'clock p. m. April 30, 1917.

MR. SHERIDAN: If the court please, I think I would like to have Prof. Taggart give a resume of the fact which the pictures of the froths will show.

PROFESSOR TAGGART, recalled.

THE WITNESS: This is a drawing, similar, I think, to a drawing that was made the other day to show the situation of affairs at the surface of an air bubble in an oil contaminated pulp, containing sulphide mineral.

Q. Something like defendant's exhibit No. 128?

A. Yes. There is a bubble of air surrounded directly at the air-liquid contact with an oil rich layer, which grades in concentration from maximum oil concentration at the air-liquid surface to maximum water concentration removed away from the air-liquid contact. Then at the surface of the bubble, but not piercing the bubble s~~t~~o as to be in contact with the air, are the sulphide particles. Now, these for the photographs which we will show tonight will show some bubbles in that condition, with particles of sulphide sticking to the outside of the bubble. They will also show some of the bubbles that have emerged from the liquid and are found in the condition of air on one side of the bubble film, air in the other side of the bubble film, and the sulphide particles contained completely within the film, but at no place in contact with the air.

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Now, a proof of this particular contention, that the sulphide particles are at no place in contact with the air, is shown beautifully by some of the bubbles which are directly against the glass through which they were photographed in the froth. Those bubbles, in moving up along the glass, have been rubbed free of the sulphide particles by the mechanical moving along the glass, so that they present the appearance of those bubbles that the court saw this afternoon, that were not coated, which were in contact with the glass. Those bubbles may, however, be coated at other places where they are not in contact with the glass. Now, that means, that if you look through this side of the bubble it is clear along the glass, and as the photographs were taken the camera was at a point such as this (indicating) and the light was coming from a point such as this (indicating) and from those clear bubbles there will be noticed two reflections of that light, one from this surface of the bubble, and one from this surface. I think that can be illustrated rather well by looking at the reflection of light, here with this water bottle; there are two reflections of that light, one from the concave surface and one from the convex surface. Now, we will get exactly the same condition in some of the bubbles that are clear in contact with the glass in the photograph which you will see. The fact that we get those two reflection is a proof of the fact that there are no sulphide particles on the back of that bubble, sticking through into contact with the air, because if there were particles on

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the back of the bubble sticking through into contact with the air, then the back of the bubble would be dull, and would be a non-reflecting surface. I think I can show it with a rough diagram. If this represents a smooth reflecting surface and this is the source of light, and the eye is here, the gleam of that light will be recognized by the eye from this particular angle, and the angle which the beam of light makes with the plane, that is the angle A, will be equal to the angle at which the light goes to the eye; in other words, the angle of instance of the light is equal to the angle of reflection. Now, if we take a surface rough and corrugated in that fashion, the beam of light will go in the same way, but no beam of light will be recognized by the eye at this point; there will just be a general illumination, due to the diffusion on the rough surface. If the back surface of the bubble in the pulp were in this condition, as it would have to be if the bubble stuck through into contact with the air, then there would be no second reflection from the back of the bubble, but merely the one reflection from the front of the bubble that is clear and in contact with the glass.

I have represented here the rays of light as they will be reflected from the outer surface of the bubble and the rays of light as they will be reflected from the inner surface of the bubble to the eye. I think that is all, as far as that particular phase is concerned.

PROF. TAGGART: Now, the pictures will also

show that it is impossible, by visual examination, to tell whether a froth has been made with more or less than one per cent of oil; and that will further show, as more or less of an incidental feature, that it is possible by the eye to tell and distinguish in froths—in some froths at least—provided these froths have been made with different oils, but with the same oil less than one per cent of oil and more than one per cent oil, is impossible to tell from the photograph.

MR. WILLIAMS: These sketches should be marked as exhibits?

MR. SHERIDAN: I will introduce them now.

This first sketch referred to by Prof. Taggart, his diagram No. 22, we offer in evidence.

> Diagram Taggart's No. 22, admitted in evidence and marked DEFENDANT'S EXHIBIT 179.

MR. SHERIDAN: And then the second one will be offered.

> Taggart diagram No. 23 admitted in evidence and marked DEFENDANT'S EXHIBIT 180.

MR. SHERIDAN: Q. When the pictures are put on the screen first, Mr. Phillips will give us an idea of about how large the magnifications will be on the screen, how large the increase in diameter will be of the lantern slide, and then the relative size of the magnification upon the screen.

MR. PHILLIPS: Some of the photographs were

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magnified—one series of photographs were taken natural size and in making the lantern slides from those photographs they are reduced on the lantern slides and the photograph of the top of the film which are natural size, the slides are reduced to 7-11 diameter, 7-11 of one diameter. The photographs that are magnified five diameters on the lantern slide are reduced to 2 3-10 diameters; and the photographs that were magnified 15 diameters are reduced to 6.9 diameters—that is on the slides. Now, in projecting these slides, the picture on the slide is two inches wide, and we make the image of the slide and thus magnify the picture on the screen in inches, divide that by two; the width of the image in this case is three feet. That will be 36 inches. Divide that by two and then the magnification by the projection is 18 diameters and multiply the 18 diameters by the magnification on the slide in whatever case it will be and that will give the diameters of the magnification of the image, and then by squaring these diameters it will give you the number of times that the picture is magnified. The pictures of the top view are magnified on the screen under these conditions 120 times, that means about eleven diameters. The series of pictures marked No. 2, that is the photographs magnified five times are magnified on the screen 1700 times, a diameter of about 41. And the fifteen magnifications are magnified on the screen 17,000 times, 1302 diameters. Now there are a number of slides of bubbles and the bubbles are of different di-

mensions and different magnifications, and that large magnification will be 375,000 times on the screen, and the first five slides of bubbles will be magnified 64,000 and the other one will be magnified 72,000 times.

MR. WILLIAMS: Will you just go into detail a little about these magnifications?

MR. PHILLIPS: "Diameters" is lineal measure, and then the number of times magnification represents the area or square. You square the diameter to get the times.

MR. SHERIDAN: Q. Mr. Phillips, will you please tell us when a picture is thrown on the screen the particular oils that were used and the thickness of the froth~~s~~? The first number indicate the index of the particular picture; the second number, say 1, 2, 3, as to whether it is the top view of the side or the magnified five diameters or the side one magnified fifteen diameters. They are repetition, these slides are replicas of the pictures that were put in evidence but we want to put the slides in evidence so they can be shown to the court more thoroughly.

MR. PHILLIPS: That is froth from oil mixture No. 3, and the froth was a quarter of an inch thick.

MR. SHERIDAN: Professor Taggart will make a technical—any technical explanation he sees fit on each picture as put on the screen.

PROF. TAGGART: I would like to have the court notice here chiefly that these bubbles are very similar in appearance to those that we saw through the microscope the other day. These represent bubbles which have air here on the upper side, the atmos-

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phere, and upon the inner side some of the air that was beat into the pulp and has risen with this and other bubbles which have combined to form the big bubble, but the particles of mineral are within the film itself. The film raises smoothly and regularly over the particles; there are no jagged projections which would be characteristic of a mineral particle sticking through into the air. There you notice also that the froth is rather sparse in that particular particle. This represents the same froth magnified five times. The upper line of the froth comes along in about here (indicating).

MR. PHILLIPS: 120 times that is.

PROF. TAGGART: I think that is all of that.

MR. SHERIDAN: I wish you would put that screen back again. I would like to have Prof Taggart direct the court's attention to the hanging particles at the lower part of the froth.

MR. TAGGART: Yes. These are the particles. Of course on these froths that are made in the machine where the froth is not removed as rapidly as it is made, that represents the overloaded bubbles which gradually become so heavily laden that the buoyancy of the air within the mass of bubbles is not sufficient to buoy up the particles. Such a condition is not characteristic of froths that are being removed continually, and is a characteristic in the small machines where the mineral—where there is plenty of mineral present with small quantities of oil as it is with large quantities.

MR. WILLIAMS: What is the percentages of oil in that froth?

MR. TAGGART: The percentage is one tenth of one per cent, isn't it, Mr. Phillips?

MR. PHILLIPS: Yes.

MR. KREMER: The upper part of this shows the film on the glass.

MR. TAGGART: Oh, yes, just the contamination and dirt, and that will be obesrved on all of these froths that represent a magnification of five diameters. That is the upper line of the film. We get this in all cases above the top of the froth, a contamination on the glass which can be distinguished from the froth.

Now, you will notice here in this particular slide which is a projection magnified some thirteen hundred diameters the small particles plastered all over the outside of the bubbles. This mass through here represents similar bubbles of—similar bubbles very heavily coated with the solid particle. You see here these bubbles are under the water so that you are looking from the water side, from the pulp, as it were, against the bubbles, and consequently looking directly at the solid particles themselves. Now, as these rise to the surface and come out into the atmosphere, then the film has air on both sides and these particles are then wholly within the film.

MR. PHILLIPS: That is oil mixture No. 3, 0.3 per cent.

MR. TAGGART: This is 0.3 per cent; the former

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was 0.1 per cent. You will notice that there are more bubbles, the whole surface of the jar is covered in this case with bubbles. The bubbles are larger and characteristic of the froth that are obtained from the later cells of the flotation machine as they are operated in the mill, that is the solid, while the mineral has become impoverished, and the pulp has become impoverished of some of its oil. This represents the same froth magnified in the picture some 41 diameters. You will note here the presence of an enormous number of small particles. These are plastered on the outside of the bubbles and some of the bubbles can be seen in a very rough fashion here. The characteristic appearance of the bottom of the film—of a film made in one of these square glass jar machines is noticeable here, and it will be noticed a dropping is shown about the same as it was in the froth made with the smaller quantity of oil.

Here is some froth magnified 130 diameters. Now, here you will notice the reflection that I speak of, here and here and here, where these bubbles which have been or are in direct contact with the glass walls of the cell, and they have been rubbed free of the load of solids that was on that particular surface, and the material has been distributed around here. It will be a little more noticeable, the particular distribution of the load of mineral on some of the other bubbles, but you will notice here is one of the reflections from one of the surfaces of the bubble, and here is the reflection of the other surface of the bubble.

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Here are the two spots of light, and here and here, and in all these it will be found that you have two spots of light, one reflected from the smooth outer surface of the bubble and one reflected from the smooth inner surface of the bubble.

MR. PHILLIPS: That is .4 of 1% oil mixture.

MR. TAGGART: Now, this froth is considerably heavier than the preceding ones. Your honor will notice the drawing back of the bubble film where the bubbles are broken here and here, the extremely viscous condition of that film, due to the intrusion of the solid matter. I think your honor noticed that in one of the froths this afternoon. The characteristic appearance of these surface bubbles is again apparent here. There is absolutely no sign here of a particle projecting from the bubble film, the films in that case rising smoothly from the particles, and the same is true, as was shown under the microscope of the other side of the film; that is, under the microscope the two sides of that film were absolutely indistinguishable. It was a type, and it showed the surface in contact with the air, and there is air of course inside of this bubble. Now these bubbles in the side view have but one side in contact with the air, and the side that we see is the side that is in contact with the water, and consequently there the particles are not included within the film, because the film as a film is not yet formed, but merely that the oil rich layer at the air-liquid contact with solid particles held in that oil rich layer and being brought to the

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top. As soon as they emerge into the top then they are entirely inclosed.

Here is a magnification of some 41 diameters of the same froth. You will notice here the bubble outlines, and see again this still characteristic fringe at the bottom.

Here is the enlarged view of these bubbles in contact with the glass, showing the two spots, the reflection from the outer and the inner surface.

MR. PHILLIPS: One half of one per cent. oil mixture.

MR. TAGGART: This is the same oil only a greater amount, and on the surface of course it is possible to distinguish the froth produced by one-tenth or two-tenths or three-tenths of 1% from the froth produced from oil five-tenths of 1%, because in the lower quantities the froths are so starved with the small quantity of oil that they did not completely cover the surface, but from now on the froths will be sufficiently voluminous to completely cover the surface of the jar, and from now on it is absolutely impossible to distinguish between them. You will notice here again this viscous film to which your attention was called in the last picture, and again the particles are wholly within the film.

This is a magnification 41 times, again with its characteristic fringe at the bottom.

Here the magnification is 130 times with the bubbles showing generally in contact with the glass, clear and showing two spots. Now you will notice upon

this bubble that some of the solid matter has been rubbed off of the surface and that is seen on the bubble at the point where it is in contact with the glass, and of course this solid matter extends all around the surface of the bubble, except this small point or area that is in contact with the glass.

MR. PHILLIPS: 0.6 of 1% oil mixture.

MR. TAGGART: Here is the same oil, slightly more of it, and the same characteristic appearance absolutely.

This is a side view, looking through the glass, 41 diameters. The outline of the bubble here, and the fringe again at the bottom.

Here is a larger magnification.

MR. PHILLIPS: This is 1% of oil mixture.

MR. TAGGART: I don't think that there is anything peculiar about this to comment on; I have been saying the same thing over and over again about these as we went along. This is 41 diameters.

This is 130 diameters.

MR. PHILLIPS: 1¼% of mixture.

MR. SHERIDAN: Q. Point out those viscous films again.

A. Here are the bubbles which have broken this way, and have drawn back. The persistence of course of these films as a sort of sheet is a sign of their high viscosity.

Here is the same film magnified 41 diameters. Here again, magnified 130.

Q. You see some of those birdseye bubbles there?

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A. I see the spots in here just the same.

MR. PHILLIPS: This is 1½% of oil mixture.

MR. TAGGART: Here again the film is so like those that were shown before that it is useless to point out the particular characteristics.

This is a magnification 41 diameters. You notice that the fringe at the bottom is no more pronounced than it was on the lower quantities of oil.

Here is the high magnification with these characteristic bubbles showing the reflection from the front and the back surface.

MR. PHILLIPS: This is one-tenth of one per cent. eucalyptus oil.

MR. TAGGART: There you can see a decided difference from the one-tenth of one per cent. of this so called oil mixture. You will remember that in the one-tenth of one per cent oil mixture there were bubbles around covering the surface with the exception of an area which would be included about where my pointer has passed. Here the bubbles are so scarce that the surface presents the appearance merely of a broken scum as it were, on the surface. These dark spots represent where bubbles have broken, and the surface is not covered with solid matter; in other words, you can see the water at those points.

MR. WILLIAMS: It should be noted here on the record that this froth was produced with California eucalyptus oil, which has never been used in the flotation process, and it was not made with the Australian eucalyptus oil which has accomplished such wonderful results.

MR. TAGGART: This is the side view of that particular froth of which we just had the top. Here you can see that there was a slight froth which was apparent at the surface.

MR. WILLIAMS: Do you know where the line of that froth ends?

THE WITNESS: About here.

MR. SHERIDAN: Just above the bubbles?

A. Yes.

Q. How is the characteristic fringe, pronounced or not?

A. It is rather pronounced.

Here is the same froth magnified to the high diameter.

MR. PHILLIPS: This is five-tenths of one per cent. California eucalyptus oil.

MR. TAGGART: Your honor will notice here a very decided difference between this particular froth and the froth that was formed with the five-tenths of one per cent oil mixture; in other words, it is quite easy, not to say the particular oil with which a froth was made, but with many froths, to tell that they were made with different oils. However, given the same oil and varying, not the conditions but the quantity, then the problem of distinguishing the froth is an impossible one, visually.

Here is the magnification 41 diameters of the froth which has just been shown. The upper line of the froth runs through in some such position as this; I think it probably runs up a little like this. ~~with this~~, with this bubble rather up in the corner.

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Here again we have the characteristic two spots reflected from the bubbles whose surfaces are in contact with the glass or film.

MR. PHILLIPS: This is 2% eucalyptus oil, and the mineral in this case is chalcopyrite and silica. This is a side view, 41 diameters.

MR. TAGGART: We do not have the top of that froth?

MR. PHILLIPS: No.

MR. TAGGART: There is an apparent difference in that froth from the others that we have seen, due, evidently to the different mineral and to the great quantity of mineral in the froth. There is some froth there which shows the bubbles in contact with the glass, but they have not been sufficiently agitated, or they are too heavily loaded with the particles to rub them clean, so that we do not get the reflected surfaces as before. The white dots in these bubbles represent the reflection from the surface of the sulphide minerals. You will notice that the type of the reflection here is very different. On the other bubbles the reflection unquestionably was not mineral, because mineral does not distribute itself in this fashion on the bubbles. Here the promiscuous distribution of the mineral on the bubbles is not a similar case at all.

MR. PHILLIPS: This charge was made up according to the California Journal of Technology, mechanically mixed.

MR. TAGGART: Here again we have an obviously different appearing froth from either of the two pre-

vious froths, the difference being due, however, to the fact that different ingredients were used in forming the froth, not that different percentages of oil were used.

There is the side view of the same froth, magnified 41 diameters.

Here is the highly magnified view, 130 diameters.

MR. PHILLIPS: This was the same charge, only it was mixed by hand in a mixing bottle.

Q. BY MR. SHERIDAN: Just as it was on the judge's desk?

MR. PHILLIPS: Yes.

MR. TAGGART: The white streak down here is a reflection from the rounded surface of the bottle. The other photograph was taken in a square jar.

This is the same highly magnified, 130 diameters.

MR. PHILLIPS: These are bubbles of one-tenth of one per cent. eucalyptus oil.

MR. TAGGART: These are very much more magnified than any of the previous ones, are they not?

MR. PHILLIPS: They are magnified 64,000 times, 252 diameters.

MR. TAGGART: These were made by taking some of the froth from the machine and placing it in a small tube about one-eighth of an inch inside diameter, and then filling the tube up with water and corking both ends, so that the bubbles were completely immersed in water, and the tube was laid on its side and photographed. You will notice here even more distinctly than in the other photograph, the rough appear-

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ance of the outside of this bubble. These are the solid particles stuck onto the outside of the bubble, inclosed within the oil rich adsorption film at the air-liquid contact surface.

MR. WILLIAMS: What is that bubble at the upper right hand corner?

MR. TAGGART: Perhaps Mr. Phillips can tell us if he recollects the particular appearance of that. He probably does not. You see these are magnified 250 times, Mr. Williams.

MR. Phillips ~~WILLIAMS~~: 252 times.

MR. TAGGART: So you don't notice a particular spot one-two hundred and fiftieth of that size?

MR. PHILLIPS: That is a bubble with no mineral, water on that face, directly in contact with the glass.

MR. WILLIAMS: Were those bubbles up against a glass surface?

MR. PHILLIPS: Yes, they were.

MR. WILLIAMS: So that they are a little bit flattened?

MR. PHILLIPS: Not very much; they probably are a little flattened.

MR. TAGGART: They were against a round surface; they are contained in a glass tube about one-eighth of an inch inside diameter.

MR. SHERIDAN: In that upper right hand corner are those the characteristic two high lights?

A. They look like it, but I would not care to say.

MR. PHILLIPS: No, they are not.

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MR. WILLIAMS: I think I can see about four, myself.

MR. TAGGART: I think so; I would not want to say about those; I think there are several.

MR. WILLIAMS: What is that in the upper left hand big bubble, that dark space in the middle with spots in it?

MR. TAGGART: I think very likely that is the place at which the bubble is in contact with the glass, and the solid has been abraded away at that point. I looked at some of those bubbles under the miscroscope, but not quite as high a magnification this morning, and that is quite a characteristic appearance, as this is also, where that particular bubble has been bumped at that particular place, and the mineral has been moved over and moved back here.

MR. PHILLIPS: These are bubbles taken from a charge containing one-half of one per cent. eucalyptus oil.

MR. TAGGART: And the previous one was how much?

MR. PHILLIPS: One tenth of one per cent. These are the same magnification.

MR. PHILLIPS: These are the same magnifications.

MR. TAGGART: Note the difference in the appearance of these bubbles.

MR. PHILLIPS: These are bubbles taken from a charge containing 0.1 per cent of mixture No. 3 magnified the same, 250 diameters.

These are bubbles taken from a charge containing 0.5 per cent oil mixture No. 3, 250 diameters magnified.

PROF. TAGGART: You will notice the characteristic two spots in these various bubbles, that are observable.

MR. WILLIAMS: Those are air bubbles, aren't they?

PROF. TAGGART: They are not completely clear, Mr. Williams, but there isn't a particularly heavy load on them.

MR. PHILLIPS: They are air bubbles separated from the water in part.

MR. WILLIAMS: To my mind they are clear bubbles, showing similar reflected surfaces.

PROF. TAGGART: Similar reflected surfaces, certainly, to those that we had before.

MR. WILLIAMS: They have no metal in them?

MR. TAGGART: Some of them have. I noticed this morning in this examination that I spoke of that those particles are very lightly loaded—this is, most of them. I could not say all because I was not looking to see whether all of them bore a load, but most of these bore a light load of mineral. Of course it was not nearly so heavy a load as was borne by the big particles.

MR. PHILLIPS: That is a mixture containing one and one half per cent of oil mixture, magnified 250 diameters.

MR. TAGGART: And the previous one was how much?

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MR. PHILLIPS: 0.5 per cent.

MR. TAGGART: I would like your honor to look closely at this and then we will go back to the previous one, for this one is 0.5 per cent above the line and the other 0.5 per cent below. Except as a matter of different illumination it seems hard to note any distinction between the two slides.

MR. PHILLIPS: This is the same mixture, same kind of bubble, 1.5 per cent of oil mixture.

MR. SHERIDAN: Enlarged how many itmes?

A. 64,000.

MR. WILLIAMS: 64,000.

A. 252, as before.

MR. WILLIAMS: 250 diameters.

MR. PHILLIPS: 250 diameters. This is a bubble from a charge containing two per cent of eucalyptus oil and the magnification is 612 diameters or 375 thousands.

MR. TAGGART: And a different mineral is used there.

MR. PHILLIPS: And the mineral is chalcopyrite and silica.

MR. TAGGART: I think the difference here in the appearance of the bubbles is largely a question of the mineral.

MR. PHILLIPS: I would like to state that that bubble is interesting. In fact, in putting this bubble in and putting the cork on top, they put too much pressure and they condensed the air bubble and the coating of the bubble was ruptured and it was so well formed that it very nearly retained its shape.

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This bubble is from a charge containing two per cent eucalyptus oil, the same mineral, chalcopyrite and silica and magnified 270 diameters or 72,000.

This was wood tar oil 0.1 per cent, Butte & Superior ore.

MR. TAGGART: Here again you see these characteristic two spots on these bubbles in contact with the side of the cell, it being borne in mind that these are photographed under water.

MR. PHILLIPS: That is wood tar oil 0.3 per cent.

MR. SHERIDAN: What ore?

MR. PHILLIPS: Butte & Superior ore.

MR. TAGGART: And note that the froth is very sparse. That represents about the upper line of the froth on this particular picture. The part above is the dirt on the sides of the cell. Here we have the higher magnification with the same froth.

MR. PHILLIPS: This is 0.3 per cent wood tar oil, Butte & Superior ore.

MR. TAGGART: Again the surface of the froth shows very clearly the characteristic bubbles. The flattened effect between the—The flat effect, although the complete surface of the jar is covered. There again we have a thin froth.

MR. SHERIDAN: Side view.

MR. TAGGART: This is the side view, 41 diameters, the upper line of the froth runs across about here.

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MR. WILLIAMS: Isn't that a case of very small bubbles, as the enlargement would bring it out?

A. We will be able to see on the next bubble. The bubble appears to be about the same size as in many of the previous ones.

MR. WILLIAMS: I see a bubble there with four reflections on it.

MR. TAGGART: Yes, I have an idea that there are two bubbles there.

MR. ~~WILLIAMS~~ Phillips: 0.4 per cent pine tar oil, Butte & Superior ore.

MR. TAGGART: Here again we have this characteristic froth. The froth is in contact with the air particles wholly included within the whole surface froth.

MR. PHILLIPS: This is the 41 diameters.

MR. TAGGART: It is characteristic—you see it is characteristic of that oil that the bubbles were considerably larger than on the other oils used, do you not.

MR. PHILLIPS: Very much larger.

MR. TAGGART: The upper line of the froth is about here.

Here we have the 70 magnification and the bubbles are sufficiently heavily coated and sufficiently tough so that the cell matter has not rounded off in contact with the glass.

MR. WILLIAMS: As I read that those are separate bubbles, with the dark lines between them?

MR. TAGGART: Yes, sir. We will see two, five.

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six, rather large and one rather small bubble complete the main point of that particular film.

MR. WILLIAMS: I think that that particular picture shows how, when bubbles are crowded against each other, the adjacent walls flatten out to almost planes. I think that shows that very well, when they are crowded together in the froth.

MR. TAGGART: I should most certainly expect some flattening, yes, sir.

MR. PHILLIPS: This was 0.5 per cent pine tar oil. That same thing is shown clearly here. This is the top view, but the junction is practically straight lines. This is a characteristic of any substance closely packed.

Here is the same froth, side view, magnified 41 diameters, showing one of two clear spots here where the film has been rubbed off one side by the contact with the glass and here is the same froth magnified 170 diameters showing approximately the characteristics of the previous one.

MR. PHILLIPS: 0.6 per cent pine tar oil.

MR. TAGGART: There is no difference in this top view to comment on. The top of the froth in this particular view is about in there.

MR. SHERIDAN: Side view?

MR. TAGGART: This is a side view magnified 41 diameters. Here again it is similar to the previous one and here is the side view magnified 170 diameters. I do not think that needs comment except for similarity.

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MR. PHILLIPS: This is one per cent pine tar oil.

MR. TAGGART: Again you note we have the characteristic bubble, too.

MR. SHERIDAN: Right there, near the lower left hand corner we see a kind of small raised point and one large bubble. What is that?

MR. TAGGART: I have an idea, Mr. Sheridan, that that is a smaller bubble. I do not think there is a larger particle being held there. The small bubbles will sometimes appear on the surface of the larger ones and give that same appearance. I think, however, that up here at the upper left-hand corner, a little just to the left, there are particles included within the film. It is rather easier to tell that under the microscope, where you can see whether the particular protuberance has a small particle within or ore in air, but I think that this one is too large for a small particle.

Here is the side view magnified 41 diameters of the same film. This I think you said was one per cent?

MR. PHILLIPS: One per cent.

MR. TAGGART: The top of the froth being about along here and the froth being sufficiently light, there is no need to call attention to that. Here again you see the same froth magnified 170 diameters.

MR. PHILLIPS: 30. One—1.15 per cent pine tar oil.

MR. TAGGART: This again is evidently similar to the previous froth. The side view magnified 15 diameters with the top of the froth coming in to about here. And here the froth is again magnified 170

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diameters. The bubbles are heavily laden with solid material.

MR. PHILLIPS: Two per cent pine tar oil, Butte & Superior ore used on all of these tests, these pine tar tests.

MR. TAGGART: You will notice here this characteristic leathery appearance of the things, and here is one of the bubbles broken and with rather viscous film between as seen in the photograph; and a side view of the same froth magnified 41 diameters; the top of the froth running into about through here.

THE COURT: Why do the bubbles seem so much more towards the bottom than towards the top? They are not so distinct.

A. Some of these bubbles are drawn up along the sides. You know that the froth is higher on the sides than in the center and you get the contact then of that upper bubble with the one directly under it, which outlines this particular contact. The dark spaces above here represent the spaces below which the tops of the top bubbles lie, and the line here represents the point above which, and I have drawing my pointer at some point in through these two as representing approximately the top.

Here is the same froth magnified 170 diameters with a characteristic appearance of the preceding ones.

MR. PHILLIPS: We have no good night slide, but I think that is the last one.

MR. SHERIDAN: I would like, if your honor

please, to offer this box of lantern slides in evidence, *en bloc,* as defendant's exhibit 181, and I would like to do this with them if Mr. Williams will agree, and that is I would like to have them remain in our possession with a right to call for them at any time.

MR. WILLIAMS: Yes, I think that would be more convenient for each party showing films or pictures of this kind.

THE COURT: The record will so show. I suppose that completes it.

The slides admitted in evidence and marked DEFENDANT'S EXHIBIT 181.

WHEREUPON an adjournment was taken until 10:00 a. m., Tuesday, May 1st, 1917.

Tuesday, May 1st, 1917, 10 o'clock a. m.

THE COURT: In the matter of the application to file the supplemental and amended bill, which is also a bill in intervention, but of course it is not the labels on the bill which control, it is the substance of the bill; and even though they may not have placed upon the bill all the labels it ought to bear, it is no objection to its being filed.

This amendment proposes to bring in other parties in intervention; they themselves are here, asking, in

that they have a right as licensees of this patent to share in the proceeds of the action, insofar as there is a recovery for infringement at all. It seems to be and it ought to be the practice in patent suits to join the patentee and his licensees, in that it makes for singleness of action and prevents multiplicity of action.

As a matter of fact, if defendant knew that this patent right had been in fact assigned to licensees, and failed to make it known, and had allowed the patentees to secure a full recovery, they would still be liable to the licensees for what was properly theirs; the same as in the case of the assignment of a cause of action; if the debtor does not insist upon the assignee, if the suit is by the assignor, being brought in, and lets the assignor recover, the debtor is still subject to the claim of the assignee, so that it is really for the benefit of the defendant in this suit that these parties should be brought in. At the same time the court, knowing this, of its own motion would insist upon it, because certainly this court does not want to try this case or any part of it again, and it would be obliged to if these licensees were not here.

Now, the other feature of the proposed amendment enlarged upon the fact that the Hyde case had been decided, the decree and mandate. As the court stated the other day, as far as it is for the purpose of pleading *res adjudicata,* it is really anticipating the defense, that that too has been customary in patent suits. I notice in a Supreme Court decision a few days ago, and I failed to make the notation, though it is within the last 50 volumes, which makes it very definite to you of

course—the Supreme Court casually observed that former adjudication should be either pleaded or introduced in evidence, without commenting on the practice. The patentee, no more than anyone else, is bound to anticipate a defense. They could introduce it in evidence without pleading it. In this case when the former adjudication, by name at least, is against a party not party to this suit, fairness to the defendant requires that it should be pleaded, but it could ordinarily be introduced in evidence after the defense of invalidity is made, no replication being necessary. That is only the general law of practice and pleading.

Now, as to lack of diligence, the condition in respect to that is the same as it was when the defendant a few days ago asked leave to amend their defense and introduce new patents and the California publication. The court said there that the peculiar circumstances of this case would serve to render the delay, not lack of diligence, because both parties were resting quiescent in a large measure, waiting for the decision of the Hyde suit. So here, as far as there not been diligence in bringing forward these assignees or licensees, the court does not think the objection is well taken, for, as I said before, the court would order them in; intervention may be had at any time prior to the conclusion of the suit, as long as it does not operate to the prejudice of the defendant, and it does not in this case. None of this new matter in the supplemental bill is any surprise to the defendant, and so the amendment, or the supplemental and amended bill and bill in intervention will be allowed to be filed.

MR. KREMER: Your honor will allow us an exception?

THE COURT: Exception will be noted.

MR. KREMER: And will your honor make a further order providing in what time we shall answer?

THE COURT: What time would you like, five days?

MR. KREMER: Ten days; I think we will be here that long, surely.

THE COURT: You are to conclude your case this week, as I understand it, and you ought to answer before you conclude. I will give you until Saturday morning. There is nothing new in this, really.

MR. KREMER: No, it is merely the preparation of the answer, the mechanical part of it. The answer will be in form the same as the one now.

THE COURT: Saturday morning.

BEN H. DOSENBACH resumed the stand for further

CROSS-EXAMINATION.

X-Q. 422. To complete the record of November 1, 1913, what oils were used on that day?

THE COURT: Now you are inquiring with respect to what? Your question relates to a former one, but that former has passed out of the court's mind.

MR. WILLIAMS: I was inquiring about the operations of the plant on November 1, 1913, that being

the earliest day of which he had any record with him and I am completing that record now?

A. The oil used on November 1, 1913, was 1.29 pounds pine oil per ton.

X-Q. 423. Was heat used on that day?

A. Heat was used on that day.

X-Q. 424. Was sulphuric acid used on that day?

A. Sulphuric acid was used on that day.

X-Q. 425. I don't think I obtained from you the tonnage of the feed to the flotation plant on that day?

A. The tonnage was 1181 tons to the mill on that day; and until such time as I can segregate that part of the concentrate which was made in the concentrator from that which was made in the flotation plant, I cannot determine exactly what the feed to the flotation plant would be on that date. This is the total amount of zinc concentrate for this day and it does not show the tonnage of lead; that is plus the mill feed, independent of the flotation plant.

X-Q. 426. What would be your method of calculation?

A. My method of calculation would be the tonnage of the lead concentrate plus the tonnage of the zinc concentrate produced in the wet concentration portion of the mill subtracted from the mill heads or tonnage to the mill; that would give the total amount of ore to the flotation plant.

X-Q. 427. That is to say all the material except the concentrate taken out by wet concentration goes into the flotation mill?

Ben H. Dosenbach.

A. That is so.

X-Q. 428. And is this method of calculation the method that has been used throughout?

A. It is.

X-Q. 429. There has been no different measurement taken of the dry feed to the flotation plant?

A. We have no definite method other than the calculating method, by deducting the products that are taken out before the feed comes to the flotation plant.

X-Q. 430. Now, have you the record for September 13th?

A. September 13th—as to what, Mr. Williams?

X-Q. 431. Have you here the monthly summary and averages for September, 1913?

A. Yes, I have the tons milled and I have the power and the oil and acid and I can give the assays for September, 1913.

X-Q. 432. Individual assays for the different days' runs?

A. Some I haven't got them segregated it has been impossible for me to get all the material together from that. Any particular day that you might want I can give those days and give you all the information on those days. There is quite a voluminus record to go through.

X-Q. 433. Well, I would like to have a daily itemized statement for some time in September?

A. 1913?

X-Q. 434. 1913, which would approximately give the day on which the concentrates were made that were

found on a car in Oklahoma on September 18th, 1913, making allowance for the usual delay in transportation?

A. I don't know how I can get that.

X-Q. 435. Somewhere about that time. I presume that you didn't make any great changes then and you can take some day which in your judgment would be about the time that these concentrates were made, and let me have that day and the days thereabouts. You have got that record, but you haven't it here with you?

A. No. Maybe anywhere from one to three months or nine months before that; maybe less and maybe more.

X-Q. 436. Bring the daily record of that time and we will probably be able to get something that will be of assistance. Tell me, however, what oils you were using in September, 1913?

A. We were using pine oil and some oleic acid.

X-Q. 437. Pine oil and what?

A. Some oleic acid.

X-Q. 438. And what general proportions of pine oil to oleic acid?

A. Approximately I should say fifty of each.

X-Q. 439. And the total oil was how much to the ton or what percentage of the feed?

A. In September, 1913?

X-Q. 440. In September, 1913?

A. In September, 1913, the oil used was 2.799 pounds per ton based upon a ton of mill heads.

X-Q. 441. Mill heads to the flotation plant?

Ben H. Dosenbach.

A. Mill heads, that would be the heads to the mill, of new ore. That would make it slightly above that per pounds per ton of flotation feed.

X-Q. 442. When did you commence using pine oil?

A. We started to use pine oil about June, 1913.

X-Q. 443. And what was the oil proportions and the mixture at that time?

A. The amount of oil used July was 4.24 pounds, so it would be approximately four pounds.

X-Q. 444. The average oil used during July was 4.24 pounds per ton of what?

A. Per ton of ore to the mill.

X-Q. 445. MR. WILLIAMS: In what manner was that oil proportioned; was it oleic acid or pine oil or pine oil alone, or what proportion?

A. There were some days when pine oil was used alone, and some days when it was used with oleic acid, but I should say the proportion at that time, was about 50% of each.

X-Q. 446. I asked you for June.

A. There was only a day's run made with pine oil in June, consequently I gave you July.

X-Q. 447. How long did you continue to use a mixture of pine oil and oleic acid in the proportion of about 50% of each?

A. Well, the proportion varied from fifty to forty and sixty. We continued the use of pine oil and oleic acid for some time.

X-Q. 448. Until when?

A. Until the latter part of 1914.

Ben H. Dosenbach.

X-Q. 449. Then what oil did you use?

A. Then we used pine oil alone. We were, at this date here, using oleic acid together with pine oil in August.

X-Q. 450. When you used pine oil alone, in what proportion or amount did you use it?

A. Approximately after that it was 1.64 lbs. per ton.

X-Q. 451. What day's record have you given me?

A. That is December 30th, 1914, the average to date for that month. That gives you a fair average.

X-Q. 452. How long did you continue to use pine oil alone?

A. We continued to use pine oil alone, and being the principal oil that we used until December, 1916.

X-Q. 453. December first?

A. No, December 22nd, it being understood that the pine oil was the principal oil that we used. However, we had occasional carload of other oils that we tried out, such as Barrett oil and pine tar oils and oils of that sort, but the principal oil that we used was pine oil.

X-Q. 454. Well, take the record of November, 191~~3~~6, and give me the oils or the mixtures that you used during that month. The record that you now show me is for November, 1916, and that does not give you the information you want.

A. It does not, but the one previous to that, October 31st, 1916, will give you the average amount of oil for that month of October.

Ben H. Dosenbach.

X-Q. 455. Give me that figure.

A. 1.50 lbs. of pine oil.

X-Q. 456. Any other oils used during the month of October, 1916?

A. No other oils used.

X-Q. 457. Now, give me the record of October 31st, 1916.

A. The ore milled was 2,122 tons. The mill zinc concentrate obtained was 75 tons. The lead concentrate 20 tons.

X-Q. 458. That was water concentration?

A. By water concentration. The flotation concentrate that was obtained was 526 tons.

X-Q. 459. And the tailings?

A. The average assay of the tailings was 1.19.

X-Q. 460. The tonnage of the tailings?

A. Well, I will figure it for you.

X-Q. 461. That is not given on the sheet?

A. We do not keep the tonnage of the tailings, no. The tonnage of the tailings was 1,501 tons.

X-Q. 462. How did you compute it?

A. By subtracting the products that were obtained in the mill from the ore that was milled.

X-Q. 463. Now, give the assay of the concentrates from the flotation plant.

A. The assay of the concentrate of the flotation plant was, for the first shift, 55.2% of zinc; of the second shift, 55.3, and for the third shift, 55.6.

X-Q. 464. Now, what was the assay of the zinc concentrate from the water concentration part of the plant?

Ben H. Dosenbach.

A. For the first shift, 46.7; for the second, 48.4 and for the third, 47.9.

X-Q. 465. On that date did you use sulphuric acid?

A. On that day sulphuric acid was used.

X-Q. 466. In what amount?

A. I haven't it for the particular day, but I have it, the same as I have the oil, for the average for the month, to and including that day, which is 5.059.

X-Q. 467. Did you use heat on that day?

A. A very little heat was used; however, the temperature, as I remember it in 1916, we were operating at about 35° C.

X-Q. 468. And you used steam in order to get it up to that temperature?

A. Oh, yes.

X-Q. 469. Did you use any other reagents on that day besides those you have given?

A. On that day we used copper sulphate solution.

X-Q. 470. How much?

A. That was equal to one-tenth of a pound of metallic copper per ton.

X-Q. 471. Per ton of what?

A. Per ton of ore milled, the same as the oil and acid was based upon.

X-Q. 472. When did you commence to use copper sulphate?

A. It was about July, 1915.

X-Q. 473. And did you continue to use it from then on?

A. We did.

Ben H. Dosenbach.

X-Q. 474. When you started in July, 1915, how much copper sulphate did you use?

A. We used about .25 of a pound of metallic copper per ton of ore milled.

X-Q. 475. And when was that increased, or was it increased?

A. It was decreased.

X-Q. 476. And when was it decreased? And to what amount?

A. Gradually decreased until about the latter part of 1915, when it was found that the results were as good with one-tenth of a pound metallic copper per ton of ore.

X-Q. 477. And that is the figure—this figure that you give is not the figure representing the copper sulphate, but the figure which represents the amount of copper in the copper sulphate, is that right?

A. Exactly so, yes.

X-Q. 478. And that one-tenth of a pound of metallic copper per ton of copper sulphate, how long was that continued?

A. Well, that has continued up to the present time. Right now it is about .08, or a little less.

X-Q. 479. Any other reagents used besides what you have testified of?

A. None, other than as a settling agent, sodium chloride; we used salt.

X-Q. 480. Where?

A. For the slimes.

X-Q. 481. For the settlement of the slimes in thickening?

Ben H. Dosenbach.

A. In thickening.

X-Q. 482. And of course that salt goes into solution in the water?

A. It does.

X-Q. 483. And flows through the flotation plant?

A. It does.

X-Q. 484. Could you give me an idea of how much sodium chloride is present in the flotation plant as the result of that?

A. I could not.

X-Q. 485. What is the general measure of its use?

A. We measure it on the amount of ore that is milled, and that figure is about .87 of a pound for the month of October, 1916, per ton of ore milled.

X-Q. 486. .87 of a pound of sodium chloride?

A. Yes.

X-Q. 487. Do you continue to use sodium chloride or common salt for the settlement of slimes at the present time?

A. We do.

X-Q. 488. And in the same amount?

A. Substantially so, yes.

X-Q. 489. This copper sulphate solution that you used, from where did you obtain it?

A. The Anaconda Mining Company.

X-Q. 490. Have you any analysis of it?

A. Contains about 1.3%, approximately, of metallic copper; contains some salt and some acid.

X-Q. 491. Does it contain any copper chloride?

A. I have not made determinations for copper chloride on that.

Ben H. Dosenbach.

X-Q. 492. Do you happen to know what kind of a product it is?

A. It is the Leach solution which is obtained from the leaching plant of the Anaconda Company.

X-Q. 493. The solution that has done its work in the leaching?

A. No, the solution that results from the leaching by sulphuric acid.

X-Q. 494. And that is the copper sulphate that you have used in all your experiments here?

A. Exactly so.

X-Q. 495. Well, haven't you an analysis of that material that you can give me?

A. I might have with me, I am not positive about that. I can make a search and see.

X-Q. 496. Suppose you look it up and get it later so that the court won't have to wait?

A. All right.

X-Q. 497. How about the water that flows through your flotation plant? What is your water system? Where does the water come from that goes through the plant?

A. Why, part of the water comes from the North Butte extension property which is situated and located about a mile from the Butte Superior plant, and part of it comes from the city of Butte and the balance is reclaimed water that is used over again from the settlement of the slimes.

X-Q. 498. And from the concentrate?

A. Also from the concentrate.

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X-Q. 499. That is to say, you economize by getting the water out of your products and sending it back again through the system? Is that right?

A. Yes, sir.

X-Q. 500. Now, I want some of the proceedings after December 22nd, 1916. We will take the period from February 4 to 28th, 1917, and I note that you give the assay of the feed to the flotation plant as 13.29 per cent zinc, and the ore to the flotation plant plus circulating middling treated in flotation as 20.25 per cent zinc. How was that arrived at? By measurement or computation?

A. That was arrived at by determination, assay determination.

X-Q. 501. By assay of the total feed?

A. Ore to the flotation plant plus the circulating middling treated in flotation.

X-Q. 502. Now give me the figures about the circulating middlings. In the first place give me the tonnage of circulating middling?

A. I haven't the tonnage of circulating middling. The tonnage that is given here is the tonnage of ore to the flotation plant, 26,262 tons.

X-Q. 503. Is that new feed?

A. That is new feed which contains 13.29 per cent zinc. The ore to the flotation plant, plus the circulating middling treated in flotation contains 20.25 per cent zinc, but I have no tonnage of that material. It is impossible to get it.

X-Q. 504. Well, do you take a sample of this total

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feed and do you from this sample make an assay to determine the amount of copper in it?

A. As before stated, I make an assay to determine the amount of copper in it.

X-Q. 505. And zinc?

A. Yes.

X-Q. 506. And you do not consider the tonnage of the middlings returned?

A. No, the middlings returned go right with the original ore when it comes in; it is all elevated together to the machine.

X-Q. 507. Well, then, in the absence of that tonnage can you give me the zinc content of the middlings returned?

A. No, I can't give you the zinc content of the middlings returned.

X-Q. 508. Can you give me the amount of oil in the middlings returned?

A. I cannot give you the amount of oil in the middlings returned.

X-Q. 509. Or the percentage?

A. Nor the percentage either.

X-Q. 510. The only measurement that you have is the measurement of the amount of zinc in the middlings returned? Is that right?

A. The only measurements that I have is the amount of zinc in the feed to the flotation plant plus the circulating load; and I also have the oil determination for that material. That is the actual material that goes to the machine.

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X-Q. 511. Can you, Mr. Dosenbach, compute the tonnage of the middlings and the amount of oil in the middlings from these figures?

A. It might be approximately computed, if you have the two determinations and one tonnage.

X-Q. 512. State what your method would be?

A. Why, having the total tonnage to the flotation plant containing its relative amount of zinc, having the assay determination of the material to the flotation plant, which includes that tonnage of the original ore plus some indefnite tonnage that contains some indefinite amount of zinc, it might be possible to. I have not gone over it to see.

X-Q. 513. Have you a general idea of the richness of these middlings and the amount of zinc which they contain?

A. Why, it can be seen that if the feed to the flotation plant plus the circulating middlings that is treated in the flotation plant, which is the flotation machine feed, contains more zinc than the original ore did, why it is quite possible that the middlings returned is richer than the original ore that came in, so as to bring the average of the two up to a percentage, which in this case is approximately seven per cent richer in zinc than the original ore.

X-Q. 514. That is obvious. But I asked you whether you had any idea as to the richness of these middlings?

A. The middlings possibly might run on the average 25 or 30 per cent zinc.

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X-Q. 515. Of course if they run much higher than that they would not be returned as middlings? Isn't that true?

A. Yes, that is very true.

X-Q. 516. I think you made a general statement about the proportion of middlings returned to feed. Now, what definite basis have you for that statement? You said sometimes it was greater than the original feed?

A. Yes. The basis of that is that a glance at the tailings of the feed to the flotation machine itself would give you some idea that the amount of material returned is as great or greater than the amount of the original ore sent to the flotation plant.

X-Q. 517. Have you the original records of the days around February 4th to 28th, 1917?

A. I have.

X-Q. 518. Let me see them please?

A. I haven't them with me other than the tabulated data that gives each day's operation.

X-Q. 519. I would like you to bring with you the records upon which these tabulations were prepared for the period of February 4th to 28th, 1917. When you changed from the smaller quantities of oil to the somewhat larger quantities on December 22nd, 1916, what changes did you make in your mode of operations and the machines used and so forth?

A. There were no changes made in operations other than making provision for connecting the tube mill discharge direct to the flotation pyramid machine that

was put in operation on that day, and also connecting a portion of the slimes which now were the general slimes that went to the general flotation plant to that machine itself.

X-Q. 520. Well, then, that machine was put in operation on that day? That was one change?

A. That was one change, naturally it would be.

X-Q. 521. You started with a pyramid machine and where did you feed the oil to this pyramid machine or the feed to this pyramid machine?

A. Just before it went to the first cell. That was considered in the series of rougher cells; that was #2 cell on that pyramid.

X-Q. 522. At what times during your operations did you feed the oil or any portion of it ahead of the tube mill?

A. We made frequent changes of that sort and fed the oil to the head of the tube mill at various times during the operation, but found that we did not obtain any better results with the oil going to the head of the tube mill than we did with the oil going to the feed after it left the tube mill or the tube mill proper.

X-Q. 523. How long at any time did you continue to feed the oil to the head of the tube mill or ahead of the tube mill?

A. Oh, possibly we continued for a period of four to six weeks.

X-Q. 524. And when was that?

A. That was after starting in December. We made experiments to see whether it would be advisable or

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not, and then we would disconnect it and send it to the other place.

X-Q. 525. After December 22nd, 1916?

A. Yes, that is what I am speaking of.

X-Q. 526. When did you last feed the oil ahead of the tube mill?

A. To the best of my recollection it was in March of this year, the latter part of March.

X-Q. 527. Were you in the plant on Sunday morning, before the arrival of our representatives, Sunday last?

A. I was not, no.

X-Q. 528. Prior to the use of the larger quantities of oil, that is to say prior to December 22nd, 1916, did you take any part of your concentrate as first concentrate from one of the machines without retreatment?

A. Please state that again.

X-Q. 529. (Question read.)

A. Yes, we have done that.

X-Q. 530. Over any considerable period of time?

A. Not for any great considerable period of time.

X-Q. 531. What was the general practice?

A. The general practice was to clean and reclean but occasionally when the system was overloaded and it was necessary to relieve a part of the system, why the concentrate from the rougher machine with the rougher concentrate was sent to the bin for a period for a sufficient time to enable the plant to readjust itself.

X-Q. 532. When did you commence to both clean and reclean your concentrates?

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A. In November, 1913.

X-Q. 533. When did you commence to clean and re-clean and again re-clean your concentrates as you were doing last Sunday?

A. We also did that in 1913, about the time, after November, 1913; our first cleaner was arranged so that we could make two cleaners out of it.

X-Q. 534. And then in addition to that there was a re-cleaner?

A. A re-cleaner; there was a third cleaner.

X-Q. 535. Can you give me any other comparative figures of the return of middlings to original feed before December 22nd, 1916, and after December 22nd, 1916?

A. I should say that they were approximately the same, or very nearly so.

X-Q. 536. When did you install the Callow machines?

A. They were installed in the latter part of 1915.

X-Q. 537. And for what purpose have they been used since their installation?

A. They have been used merely to take care of the fluctuations that occurred in the Janney machines that are placed in the system ahead of them—take the feed before they take the feed; for instance, if a Janney machine is down, or any part of it is down for any reason whatsoever, it sort of leaves the pneumatic machines below to take care of the feed as it goes to it.

X-Q. 538. What do you mean by taking care of the feed; do you use them for producing finished concentrates?

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A. We do not; we produce middlings from these machines only, and they are merely there as a safety valve, you might say.

X-Q. 539. Their function is to clean the tailings?

A. To assist in cleaning the tailings, yes, and as a safety valve to take care of any fluctuations in the upper part of the plant, should it suddenly go down, or any part of it go down.

X-Q. 540. Before December 22nd, 1916, did you take into account the oil in the circulating middlings?

A. We did not.

X-Q. 541. Since December 22nd, 1916, you have made frequent changes, have you not, in the flow sheets as to the flow of the material to the different machines?

A. Since December 22nd, 1916, yes. The plant was changed over from the straight series type of machines to the pyramid type of machines and that necessitated the changing of the flow sheets.

X-Q. 542. And then, as I understand it, the flow sheet as exhibited to us last Sunday was different from the flow sheet as you explained it to us on Saturday, is that right?

A. Well, I did not have time to conclude it Saturday; I was endeavoring to explain the cleaning arrangements, which I showed on that flow sheet to the two cleaning arrangements, and I endeavored to show this, consequently I did not draw any line for these machines except No. 7 pyramid, to give you the actual flow through the pyramids as original material.

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X-Q. 543. When did you commence to use one of the pyramid machines as a cleaning machine or re-cleaner?

A. In February, I think it was, when we started to use it; February, 1917. Then it was discontinued again, and then it was used again.

X-Q. 544. I notice that in Exhibit 158 in the period January 30th to February 3d, 1917, the estimated recovery is given as 99.20. I note also that in the daily proceedings sheet, Exhibit 159 for January, there is an item which you explained, on January 31st, 130.70% recovery estimated. Is that figure of the calculation the one which accounts for that very high 99.20 in the estimated recoveries from January 30th to February 3d?

A. I should say that it was.

X-Q. 545. So that that particular figure, 99.20, as a representative of the recoveries on the operations of this particular test, may be treated as having been greatly exaggerated by the ordinary methods of computation and balancing up at the end of the month, is that right?

A. At the end of the month, yes, sir.

X-Q. 546. You did not furnish any table of the daily operations from December 22nd to January 1st, did you?

A. No, because there was just a portion of the plant in operation with the larger quantities of oil at that time, and the pyramid machines, as shown in one of the reports, gives the results of that particular

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operation; that is, the tailings from the pyramids after the assays had been made which are reported on that sheet, joined with the other tailings and was taken as a general sample for our regular mill record.

X-Q. 547. That is to say, it was a period of experimentation, and the operations in the larger amount of oil were practically those that appear in the table, Exhibit 163, is that right?

A. I shold say that it was a period of more or less oil used in the plant for the various machines, due to the fact that we did not have the oil to operate the entire plant, so we operated on what machines we had the oil for.

X-Q. 548. Why don't you say that it was because you were experimenting and did not know exactly how to handle the larger quantities of oil; that is the truth, isn't it?

A. It is not.

MR. SCOTT: Mr. Williams, I would ask you what you mean by large quantities of oil, whether you mean one thing or another.

MR. WILLIAMS: I think that the reports which the witness has produced of the test that I refer to are sufficient for the edification of the witness.

MR. SCOTT: Will you kindly state what you mean by large quantities of oil?

MR. WILLIAMS: Do you object to the question which I asked?

MR. SCOTT: I object to it because it is too indefinite—large quantities of oil. I refer to the last question.

THE COURT: The witness apparently understood and answered. I think the objection comes too late.

Defendant excepted.

X-Q. 549. In the following report that you have given of the daily operations, I don't find the application of the oil of the 68 different varieties of oil mixture that are described. The 53 varieties of the regular operations, shown in Exhibit 160, do not appear in the daily reports, the last one being variety No. 50, on March 31st, 1917.

A. That is 50.

X-Q. 550. There is an interregnum, is there not, in the operations of April, wherein the other three of the 53 varieties were used, as to which you have furnished no information?

A. Well, as I said yesterday, we keep our oil in numbers, and it is the only way to keep general track of the oil mixture when we are using more than one oil; consequently these three oils must have been used on one of the days in April.

X-Q. 551. You have given a general summary of April 1st, 1915. Will you give a record of the daily operations?

A. I can supply a record of the daily operations, but I think it would take the afternoon. I have been so busy in April here that I have not had a chance to do that.

X-Q. 552. Please do that so as to complete the record, and make the daily records correspond at least for

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the latter part of the work, with your general flotation operation sheets.

A. All right.

X-Q. 553. Now, I don't find in here 53 varieties of regular operations, and these 16 varieties of experimental operations are operations in the pyramid machines—that is not the exact oil mixture that has been testified of here. When was that mixture adopted?

A. Well, as I told you, that is the mixture that we endeavor to run, and in a number of instances there, while the actual figures may not show it exactly, those are the actual proportions taken by weight and the figures 70, 18 and 12 is the oil mixture used. After 24 hours of operation, the oil mixture may come out 70, 16 and 14, showing the actual weights that had been used. That is necessary to keep track of our oils.

X-Q. 554. Variety No. 28 is 10% kerosene, 70% Jones' crude and 20% of pine, which seems to me to be the nearest approximation to what you have given.

A. That is fair all right, I should say.

X-Q. 555. Where do you get this kerosene?

A. Well, that is purchased from the Utah Oil Refining Company and from the Continental Oil Company and from the Texas Oil Company.

X-Q. 556. Is the kerosene such as is sold on the market for illuminating purposes?

A. As commercial kerosene, yes.

X-Q. 557. Isn't it a cruder and cheaper grade?

A. We have had one or two cars of a cruder, cheaper grade.

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X-Q. 558. What is the Jones crude oil, and where do you get it?

A. That is an oil that comes from Kansas; it is called Jones' crude, but I think it is more of a residuum than it is a crude oil.

X-Q. 559. Of petroleum?

A. Of petroleum, yes, sir.

X-Q. 560. The No. 1 creosote, what is that?

A. That is a hardwood creosote, a fractional distillate from the hardwood.

X-Q. 561. Where do you get that from?

A. That comes from Marquette, Michigan.

X-Q. 562. No. 2 creosote?

A. That is also another fraction of a hardwood distillate, it is a hardwood distillate, and is somewhat similar to the #1.

X-Q. 563. Do you know what the difference is between the two?

A. Well, it is a difference in the fractionating of the two.

X-Q. 564. Now what is this fuel oil?

A. The fuel oil is a paraffin residuum.

X-Q. 565. Is this known as Jones fuel?

A. It is not. That is known as Graybull fuel.

X-Q. 566. Where do you get it from?

A. From Graybull, Wyoming.

X-Q. 567. Now, the pine oil, where do you get that from?

A. Principally from the Yaryan Resin and Turpentine Company.

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X-Q. 568. Do you have any pine oil which is not Yaryan pine?

A. Right now we haven't, no.

X-Q. 569. But you have had?

A. We have had other pine oils that we have tried out. Everything in that report is Yaryan pine oil.

X-Q. 570. No. 4 Barrett, that is a wood tar, is it?

A. That is a coal tar distillate.

X-Q. 571. And where do you get that from?

A. From the Barrett Manufacturing Company.

X-Q. 572. What was this oil called tar?

A. That is crude coal tar.

X-Q. 573. And where do you get that from?

A. From the Butte Gas Works.

X-Q. 574. What is this paraffin base?

A. That is a crude paraffin oil of paraffin base.

X-Q. 575. Can you complete the supply of specimens of these oils that are tabulated by you? I believe we have one or two, but not by any means all.

A. I can.

X-Q. 576. Will you do so as promptly as possible?

A. I will if you will let me know what quantity you want?

X-Q. 577. Kindly talk to Mr. Chapman or Mr. Higgins and give them what they want. Will you do so?

A. Yes, if they don't want too much.

X-Q. 578. Now, during the period before December 22nd, 1916, did you make any determination as to the circulating middlings, any assays or measurements?

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A. No. We have at times endeavored to get some experimental data of these middlings, but the volume of material that we were returning was quite great and it was very hard to get an accurate tonnage sample, and an assay of that material so I have actually taken these samples and thrown them out, for I did not think they would be accurate enough to submit.

X-Q. 579. Then you haven't any reliable record of these middlings prior to December 22nd, 1916? Is that correct?

A. I have no reliable records on the middlings prior to or after December 22nd, as to the amount and the assay.

X-Q. 580. Do I understand that after December 22nd and during the period up to the present time you have had no reliable record of the middlings?

A. As to what?

X-Q. 581. As to any part of them?

A. No.

X-Q. 582. What did you mean when you said that you had no reliable record before or after December 22nd?

A. I meant that we didn't have any.

X-Q. 583. Well, now the figures that you have given in these daily returns, do you include those as unreliable?

A. Absolutely not. This is the middlings plus the ore and not the middlings alone.

X-Q. 584. Well, prior to December 22nd have you any figures that will show the middlings plus the ore feed?

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A. I have.

X-Q. 585. Give me a record of some time shortly before December 22nd, 1916?

A. I will have to supply them for you, Mr. Williams. I can supply all of December and November of 1916 for you if you so desire.

X-Q. 586. You commenced to make up that record in December, 1916?

A. No, we made it previous to that time, as to the assay of the flotation machine headings or the ore plus the circulating middling treated in flotation, and I can supply that for an average period or any time that you might wish.

X-Q. 587. Well, supply it for November and December, 1916, and then for December, 1915?

A. All right, sir.

X-Q. 588. Now, are we to have another flow sheet which will give the actual operations as they were exhibited to us on Sunday last?

A. I will supply you with another flow sheet of the actual operations as they existed on Sunday last.

X-Q. 589. Your Janney machines are operated with what speed of impellers?

A. About 570 revolutions per minute.

X-Q. 590. And can you give me the peripheral speed?

A. I can figure it for you.

X-Q. 591. Give me the diameters?

A. 20 inches for the upper impeller and 15 inches for the lower impeller.

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X-Q. 592. And is that maintained throughout the plant, that speed?

A. That is.

X-Q. 593. Have you used an oil known as Jones fuel oil?

A. We have used an oil known as the Jones crude oil.

X-Q. 594. Have you used an oil known as the Jones fuel oil?

A. No.

X-Q. 595. You haven't used any different varieties of Yaryan pine oil?

A. Yes.

X-Q. 596. Can you describe these different varieties?

A. I can.

X-Q. 597. Please do so?

A. One variety we have used was a pine oil that was comparatively pure, while other varieties that we have used were not so pure, containing more of the solvent material, such as the paraffin solvents that are used in the extraction of the pine oil from the wood. These pine oils having a lower specific gravity than the ones which were comparatively pure, which had a specific gravity of about 0.93.

X-Q. 598. Can you give a trade description of these different varieties?

A. The pure pine oil is the Yaryan standard pine.

X-Q. 599. And the other?

A. The others are #2 Yaryan pine.

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X-Q. 600. That gives two varieties. Are there any others?

A. There are others that range between the #2 and the standard Yaryan, which numbers I don't remember offhand.

X-Q. 601. But they have certain commercial numbers, have they?

A. I understand that they have. Some we have obtained samples of.

X-Q. 602. What are you using now?

A. We are using a mixture of the standard and the #2.

X-Q. 603. How long have you used them, about?

A. We have used them for the past several months, as we have not the tank capacity to keep them separated; we have to mix them.

X-Q. 604. Since December 22nd, 1916, what varieties of Yaryan pine oils have you used?

A. The standard and the #2.

X-Q. 605. And they have generally been mixed?

A. They have generally been mixed and in some instances have not, depending upon our tank capacity. We had room in one tank to put the lone oil.

X-Q. 606. Can you give me any figures giving the assay of the middlings or whatever you call it that is overflowed from the pneumatic or Callow plant?

A. A fair average would be between five and 12 per cent zinc.

X-Q. 607. And that is based upon your assays from time to time? Is that right?

A. Yes. We don't assay them regularly, but we take occasionally a sample of it to determine its value.

X-Q. 608. Can you give me an idea of its tonnage?

A. That would be pretty hard. I have made no determinations on that particular matter.

MR. WILLIAMS: For the present and in view of the fact that there are so many other things that the witness has to supply I suspend the cross-examination.

RE-DIRECT EXAMINATION

BY MR. SCOTT:

R-Q. 609. You were asked on cross-examination something about when your attention was first called to using large amounts of oil, and you stated that—referred to some circumstance at the Utah Copper Company, I think, in the summer of 1913?

A. I did.

R-Q. 610. Will you explain that circumstance? What happened?

A. It was in the summer of 1913 when I went to Garfield, Utah, to the Utah Copper Company to assist in some flotation work for a period of two or three months. While there we determined the best methods that we knew of to float the ore or rather the low grade concentrate, and it was found that by only using coal tar or its derivatives, or a mixture of coal tar with the crude oils that good results were obtained when using a large quantity of the oil; and it was impossible to get the results at that time with a smaller

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quantity. By "large quantity" I mean we had used as high as thirty and forty pounds of oil per ton, at that basis, in the small apparatus, and the results were very much poorer with quantities that were smaller than that, say ten pounds or five pounds; and with a smaller quantity one or two pounds, we couldn't get anything. And at that time it was upon this investigation that we determined the relative importance of large quantities of oil.

R-Q. 611. Can you state about how much insoluble the Butte & Superior ore carries, mill run?

A. On an average I should say between 65 and 70 per cent. A fair average would be 67 per cent insoluble.

R-Q. 612. What would be the figure for the flotation feed?

A. Well, the flotation feed would be somewhat higher than that, possibly 72 per cent.

R-Q. 613. On account of what?

A. Having some mineral taken out of the original ore.

R-Q. 614. When you began to use upwards of one per cent of oil was the time of agitation, or the degree of agitation, time of agitation, changed in the Butte & Superior plant?

A. It was not.

R-Q. 615. Did you ever use copper in a different form from that you referred to as being purchased from the Anaconda Company?

A. Yes.

Ben H. Dosenbach.

R-Q. 616. In what form?

A. We have used copper sulphate, a solution produced from the copper sulphate crystals.

R-Q. 617. Ordinary commercial crystals?

A. Yes, ordinary commercial crystals.

RECROSS-EXAMINATION.

BY MR. WILLIAMS:

RX-Q. 618. When did you use copper sulphate produced from crystals?

A. We used that when we first started the operation in 1915 with copper sulphate. The first copper sulphate that we used was made from crystals, made into a solution.

RX-Q. 619. And about how long did you use that kind of copper sulphate?

A. Well, I don't remember exactly when we started using the A. C. M. solution, the Anaconda Copper Mining Company solution; but I do know this: at various times it has been difficult to get the Anaconda Mining Company's leach solution, and it is necessary for us to use the copper sulphate solution. We keep a stock of it on hand at all times and can change to the copper sulphate crystal solution, which gives equally as good results as the Anaconda Mining Company's leach solution.

RX-Q. 620. Well, you can give me a general idea as to when you commenced using the Anaconda Mining Company leach solution, can you not? Please do so.

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A. About a year ago, I think, approximately.

RX-Q. 621. MR. SCOTT: Have you drawings of these machines you have used in your experiments, or some of them?

A. Yes, I have.

RX-Q. 622. Have you them with you?

A. I have. I have a drawing here of the cataract machine that I used in producing the Everson procedure.

MR. SCOTT: We will put this in evidence if there is no objection, so they will be convenient in the record to refer to the different types of machines.

MR. WILLIAMS: No objection even to the violation of the fundamental principles of perspective that appears in the drawings.

MR. SCOTT: I offer the drawing of the cataract machine in evidence, this being the machine used by Mr. Dosenbach in one of his Everson experiments.

THE COURT: What machine was that?

MR. WILLIAMS: Out of the German publication. It is the oil purifying machine. Of course I have a general objection to the use of that machine.

THE COURT: It will be admitted.

Drawing admitted in evidence and marked DEFENDANT'S EXHIBIT 182.

RX-Q. 623. MR. SCOTT: Have you drawings of any of the other apparatus?

A. Here is the Janney machine.

MR. SCOTT: We offer in evidence a drawing

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showing the Janney circulating machine in section, this being a drawing of the machine used by Mr. Dosenbach in one of his experiments.

MR. WILLIAMS: I suggest that that be corrected to properly represent the machine that is in evidence. The correction is not a large one and can easily be made, showing the dome top. With that correction I have no objection.

THE COURT: Well, the correction will be made.

> Drawing admitted in evidence and marked DEFENDANT'S EXHIBIT 183.

MR. SCOTT: I offer in evidence, drawing of the square glass jar machine used by Mr. Dosenbach in his experiments.

> Drawing admitted marked DEFENDANT'S EXHIBIT No. 184.

RX-Q. 624. MR. WILLIAMS: In regard to defendant's exhibit No. 182, representing the so-called cataract machine, I observed at your plant an oil mixing machine provided with a revolving impeller and baffles, or at least one baffle. You have that construction in mind, have you not? The oil mixing machine at your plant which was mixing the oil that you ~~was~~ were using on Sunday last?

A. Yes.

RX-Q. 625. That machine has a revolving impeller about the same as in this cataract machine, has it not?

A. It has a revolving impeller.

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RX-Q. 626. About the same as this cataract machine?

A. No; it has a very narrow blade.

RX-Q. 627. It has a baffle, has it not?

A. Yes, it has a baffle.

RX-Q. 628. At what speed is it rotating in your plant, mixing the oil?

A. It is rotated at about twelve to fourteen—I should say offhand—revolutions per minute. I wish to say, however, that the oil is placed in that oil mixing tank up there, and it is not necessary to revolve the impeller any faster than it is going for the purpose that we desire.

MR. SCOTT: I offer in evidence the Janney circulating machine which Mr. Dosenbach used in his experiment.

MR. WILLIAMS: The machine, while of interest, is irrelevant as to any of the issues in this case, because the record shows that it is a machine that was invented about 1913 or 1914, and is therefore, and can not therefore, be any part of the prior art. I should like a ruling upon that, if your honor please.

THE COURT: Well, the court will allow it to be admitted. The objection is overruled.

Plaintiff excepted.

THE COURT: Experiment has been made with it before the court, and to repeat them, perhaps the machine ought to be here. The exception will be noted.

Machine marked DEFENDANT'S EXHIBIT 185.

MR. SCOTT: I offer in evidence the machine used by Mr. Dosenbach in his experiments and referred to as the cataract machine, the same following the German publication referred to by Dr. Sadtler.

MR. WILLIAMS: The same general objection; it is no part of the prior art.

THE COURT: For the same reasons the court will overrule the objection, and exception will be noted.

Machine admitted in evidence and marked DEFENDANT'S EXHIBIT No. 186.

MR. SCOTT: I offer in evidence the machine used by Mr. Dosenbach and referred to as the Fryer Hill machine.

MR. WILLIAMS: The objection to the introduction of that machine of course repeats the objection that was made to the experiments in it. That machine is a figment of the imagination of counsel, and has no part in the record or in the proceedings in court, and I object to it on the ground that it is incompetent, irrelevant and immaterial.

MR. KREMER: I don't know whether that is a compliment or not, Mr. Williams.

MR. WILLIAMS: It is a compliment to the ingenuity of counsel.

THE COURT: It is the opinion of the expert that the machine follows the publication, and experiments have been made with it, and for the same reason the court will allow the machine to be introduced in evi-

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dence and the objection will be overruled and exception allowed.

Fryer Hill machine admitted in evidence marked DEFENDANT'S EXHIBIT No. 187.

MR. SCOTT: I offer the square glass jar machine in evidence.

MR. WILLIAMS: The general objection as to that. The particular objection was to the speed at which it was rotated.

Objection overruled; plaintiff excepted.

Machine admitted in evidence and marked DEFENDANT'S EXHIBIT No. 188.

MR. SCOTT: I offer in evidence the cone Gabbett apparatus, including the up-cast appliance.

MR. WILLIAMS: As these are reproductions of the real prior art, as far as I can see, there is no objection.

Machine admitted in evidence, marked DEFENDANT'S EXHIBIT No. 189.

Whereupon further hearing was adjourned until 2 o'clock p. m. May 1st, 1917.

2 o'clock p. m., May 1st, 1917.

PROF. WILDER D. BANCROFT recalled for further

DIRECT EXAMINATION

BY MR. SCOTT:

Q. 1. You have called my attention, Prof. Bancroft, to the fact that in your testimony the other day, appearing on page 1106 of the typewritten transcript, some of the percentages you mentioned were not stated accurately.

A. Yes. I stated that one-tenth of one per cent of oil on ore was approximately 6% on mineral when the ore contained 17% mineral, and was 25% of oil to mineral when the ore contained 4% mineral. That seems to have been a case of getting lost on the decimal point; those figures should be 0.6 and 2.5 respectively, which rather spoils the burst of eloquence that I indulged in. Of course if I had realized that the decimal point was misplaced I should have said things running from 0.1 to 1%, instead of doing it as I did.

THE COURT: It seems you were indulging in agitation right then.

A. It certainly looks like it.

Q. 2. BY MR. SCOTT: Professor, will you please tell us when you first saw a mineral froth, one of these concentration mineral froths?

A. Well, as near as I can fix it, it was either the end of March or the first few days of April of this year.

Q. 3. How did you happen to see it then?

A. Why, because Dr. Sadtler telegraphed to me in the middle of the month of March to know whether I would consider coming out here and testifying in this case, and I told him that I could not tell until I had talked the matter over with him, because, as a matter of fact, I did not know which side Dr. Sadtler was on, and after that, of course, I began to get fairly busy looking up the details, because before that I had been simply interested in the general theory of it as a minor problem in colloid chemistry.

Q. 4. Your previous interest in it had been entirely disconnected from the concentration of ores; was that the case?

A. Oh, yes; I did not care anything about that. The thing that interested me in it has been that it is a practical application which connects in with two apparently different things; that is, we have emulsions, which are drops of one liquid—cod liver oil, for instance, suspended in another, and those drops are stabilized by adsorbed solids, and I have been doing a great deal of experimental work, or having it done, in the last few years, on the theory of emulsions. The next step is the theory of froths, because you can consider a froth as an extreme case of an emulsion, where you have got air or any gas, which may be considered as a very dilute liquid, instead of the liquid. One al-

ways likes to make occasional reference to the fact that these things that we have been talking about are of interest from another point of view than the purely theoretical, because the student is much more interested in the practical side than in the other, and of course the bulk oil process does come in under this head, where you have two layers of liquid separated by the metal. But the only experiments that I have ever done was this same one that has been done here, of the copper powder and of the aluminum powder.

Q. 5. Then I take it that the lectures—I think you said one lecture a year that you had to deliver—for the past three or four years, have been devoted to this theoretical and scientific aspect of the emulsions and of froths?

A. Yes, to show the connection between emulsions and froths, and that we did have these particular things coming up as a special technical application, but of course as far as I was concerned, I never cared or really knew anything about the special details, because it was perfectly obvious that if we had air in there the things would float better than if we did not have air, and from the scientific point of view the problem never came up as to the special requirements or the methods of doing it.

Q. 6. Certain passages have been quoted to you from your article in Metallurgical and Chemical Journal of June 1st, 1916, the quoted passage relating to the nature of mineral floats formed with different quantities of oil. Were these statements based upon

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your own investigation or upon information otherwise obtained?

A. Why, they were based on information otherwise obtained; that is, we had done no experiments, as is shown in the statement seven lines from the end of that article: "We have not yet made any experiments on the factors affecting ore flotations when the oil is reduced to a minimum, so I will not discuss that point at all."

Q. 7. Now, referring to the passage from this article, Metallurgical and Chemical Engineering, which was quoted in question 221, appearing at page 1144 of the typewritten transcript, have you found anything from investigations made by yourself to confirm the statements contained in the quoted passage?

A. From experiments that we have done this winter on the theory of froths, and from the experiments that I have also done since I have been out here, I satisfied myself, somewhat to my sorrow, that that is all wrong, and that it was a very unfortunate paragraph to have written.

Q. 8. Will you state how you originated the series of experiments that you made when testifying the other day?

A. It was perfectly clear to me that you ought to be able to stabilize a froth with any solid which would be adsorbed ~~by~~ in it; and, if I were considering it purely from a scientific standpoint, I would have been satisfied to let it go with the statement of the fact that you could stabilize it with zinc sulphide or lead sulphide.

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But my experience has been that in every particular industry the people think that there is something specially mysterious about that and that the ordinary laws do not apply to it. That is, the literature is full of the statements that ore flotation is essentially mysterious and uncanny. If you take the people who make leather they will tell you that tanning is entirely different from any other industry under the sun, and that no laws apply to them. You hear people say the same thing if you talk to the people who dye cloth, that is they consider that the dyeing of cloth is quite different from anything that anybody else has ever known anything about, all of which is of course not so. So it seemed wiser to take other substances which were not directly connected in any way with flotation, and Messrs. Taggart and Beach talked the matter over with me to decide what substances would be the best for the purpose of these tests. We decided on lycopodium powder because we knew that that was not wetted readily by water, and consequently had a distinct adsorption for air. We took white lead because I knew that linseed oil will displace water from white lead. While I did not know that the same thing would hold in these other cases, it seem~~s~~ed to me very probable; and the time being short we did not want to run a number of things that were likely not to work. We took lamp black because I knew that the different forms of carbon black have very strong adsorbing power and that among other things acetic acid is adsorbed by lamp black; so that these seemed to be the best things to start in with.

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I have no doubt we could find dozens of other things if we had time but it would take us about two days to show them.

Q. 9. Are there any other passages in the "Engineering and Metallurgical Journal" that you would like to comment on?

A. I have marked several passages in here which do not represent at all my present views. As regards to the other paragraphs they are not all worded quite the way I should do it now, but they are substantially correct. First, there are two typographical errors which I should like to correct. On page 632, in the paragraph beginning with the word "Winkleblech" the word "benzene" in there should be spelled with an "i," bezine and not with an "e." In the next paragraph the word "benzene" should also be spelled with an "i" in the first place in which it occurs. It is all right in the second. Those are small typographical errors which were not corrected because I did not see the proof. Now, as to the paragraphs which are pretty bad from the present point of view. On page 634 all the way from the paragraph on the left column beginning "A large bubble" to the end of the paragraph on the right hand colmn ending with "more air would give a plastic mass; with still more would give the bulk oil process." The statement in that about saponin is all wrong, and the part in there about the cause of the variation in the amount of oil is also wrong. While there are occasional sentences in there that are all right, it is safer to object to this

whole thing. On page 635 the paragraph beginning "If a pure liquid does not form a froth with air" should come out. It is a perfectly suitable paragraph in itself but as I now know it doesn't have anything to do with flotation. That point as a matter of fact is covered in my testimony the other day. On page 635 the sentence reading "Now that we are a little more clear as to the cause of frothing" should also come out because I wasn't so clear in regard to the question of frothing, especially not as regards the theory of frothing agents, as I am now. With these exceptions I think the other is practically all right. Anyhow, I am willing to be responsible for it as representing substantially my views at the present time.

MR. SCOTT: I will try and get you another one of these if you will give me this one to put in evidence

A. Yes, sir.

MR. SCOTT: I offer a photographic copy of the article in the "Metallurgical and Chemical Engineering" by way of explanation of the testimony. Any objection?

MR. WILLIAMS: No, no objection.

Document admitted in evidence and marked DEFENDANT'S EXHIBIT 190.

MR. SCOTT: You may cross examine.

MR. WILLIAMS: No cross examination.

WITNESS EXCUSED.

Frank R. Wicks.

FRANK R. WICKS, recalled, testified as follows:

DIRECT EXAMINATION,

BY MR. SCOTT:

MR. SCOTT: Mr. Wicks will testify to one of these reports regarding which Mr. Dosenbach's employment was insufficient to cover the period.

Q. 1. I hand you the tabulated report of the Butte & Superior Copper Company, flotation operations covering the period from 1913, first quarter, down to April, 1915, and ask you if you were connected with the operations there referred to for any period of the time?

A. I was connected with the Butte & Superior operations from December, 1912, until April, 1915, which would include this period.

Q. 2. In what capacity were you connected with the company.

A. I had the title of mill superintendent.

Q. 3. And you did actually have the superintendency of the mill?

A. Yes, sir, I was in direct charge of the mill.

Q. 4. And these operations were under your charge?

A. Yes, sir.

Q. 5. And you can and do state that these figures correctly represent the operations?

A. I have studied them over and I believe that they are; yes, sir.

Q. 6. Now, Mr. Wicks, have you compiled any figures showing the details of operations in the Chino

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plant covering periods when the kind of oil used remained substantially the same?

A. Yes, sir, I prepared a tabulation for the month of November, 1916.

THE COURT: This is not a matter that he has heretofore gone over?

MR. SCOTT: This is another branch of the case we are going to take up. We are going to establish the relations between the amount of oil and other elements in the process for the purpose of showing that that is not related in any way to the weight of the ore itself.

THE COURT: I asked is it a matter that he has gone over before.

MR. SCOTT: No, he has not touched on this; no witness has, your honor.

THE WITNESS: These really furnish some information that Mr. Williams requested of me.

MR. SCOTT: What question of Mr. Williams brought this point up?

A. Mr. Williams was looking over the statements showing the details of operation of the vanner concentrate flotation plant at the Chino Copper Company, and he called my attention to the variation in oil and that it was in direct ratio or in direct proportion to the fluctuations in the dilution of the feed. I told Mr. Williams that that matter had never been called to my attention particularly but that it would appear from the statements that there was some relationship. So I got up some figures to show the details of that so as

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to show whether there was any comparison or not, and when I was doing that I also prepared a statement —some statements showing the relationship between the total sulphides in the ore and the amount of oil used, which was a matter that I also mentioned to Mr. Williams at the time I was testifying about that statement.

Q. 7. Now, the figures upon this statement which you have prepared are derived principally, are they not, from the tabulated statements that you produced the other day?

A. Yes, sir, the figures are taken from that or they are computations made from those figures.

Q. 8. Has an investigation or study of these figures been made for the purpose of determining whether there is some relation between the amount of oil and the sulphide in the ore and the solution?

A. Yes, sir. I was much interested in that and I proceeded immediately to tabulate it to see what the relationship was.

Q. 9. And has this investigation put in more definite form than this statement?

A. Well, in collaboration with Professor Taggart we prepared some charts showing graphically the relationship which the figures indicate on this sheet which I have here.

MR. SCOTT: You may cross examine because Professor Taggart will explain the calculation. I offer the statement produced by the witness entitled "Chino Copper Company, Hurley plant, data compiled from statement, form 12C, showing results of operation of

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vanner concentrate flotation plant, month of November, 1916."

MR. GARRISON: We, of course, object to this as not having any probative force, if your honor pleases.

Q. 10. Is it not true, Mr. Wicks, that in the operation of the flotation plant the following factors are liable to variation: first, tonnage fed to the plant per unit of time, 24 hours being the period usually employed?

A. Yes, the tonnage varies considerably.

Q. 11. How about the kind and amount of oil?

A. The kind and amount of oil varies somewhat.

Q. 12. How about the degree of agitation and aeration?

A. The duration and degree of the agitation do not vary a great deal. There is a little variation from time to time, but not a great deal.

Q. 13. Kind and quantity of reagents other than oil, is there a variation in that?

A. Yes, sir.

Q. 14. Is there a variation in the temperature of the pulp?

A. Yes, the temperature of the pulp varies according to the weather conditions.

Q. 15. Is there a variation in the quantity of the feed?

A. A considerable variation.

Q. 16. Is there a variation in the quantity of sulphide in the feed?

A. Yes, a great deal.

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Q. 17. Is there a variation in the quantity of oil used?

A. Yes.

Q. 18. Now, in your plant, when using the minimum efficient quantity of oil, if all the conditions above mentioned remain constant except the percentage of water in the feed and the quantity of oil used, what change do you make when the percentage of water in the feed increases?

A. Well, I find from this tabulation that I have prepared that as the percentage of water increases, the amount of oil used increases.

Q. 19. In your plant when using the minimum efficient quantity of oil, if all conditions remain constant except percentage of sulphide in the feed and quantity of oil used, what change do you make when the percentage of sulphide in the feed increases?

A. When the percentage of sulphide increases more oil is required and more oil is added.

MR. SCOTT: Now, the purpose of the tabulation that we offer, if your honor please, is to show by computation and graphic diagrams actually made from the records of the mill, that the observation of the fact stated by the witness is verified, and thereby to show that whereas the patent here in suit states the quantity of oil in terms of a percentage of the weight of ore, as a matter of fact there is no relationship of that kind whatever; that the quantity of oil is related to other things entirely, namely, to the sulphide content of the ore, to the dilution of the ore pulp and

to other factors—as stated by one of the witnesses some time ago, to the degree of aeration as affecting the number of bubbles and the air surfaces in the pulp. It is our point that the patent in suit not only erroneously states by implication or by direct statement—I might say that there is what has since been called a critical point that the oil must be reduced to in order to produce this froth—we not only deny that allegation, but we also deny that the very terms in which it is stated have no relation to this process whatever, namely, a relation to the quantity of ore.

I renew the offer of this report.

MR. WILLIAMS: I have no objection to this report as it appears to be an illustrative diagram prepared to illustrate a theory; but now that we have the detail of these daily operations in this argumentative form, I think that should be supplemented by the details of these operations in the form in which they are summarized, and not particularized, in the record of the flotation operations of the retreatment of vanner concentrates, exhibit No. 29. If, therefore, this witness will supplement this argumentative report with a regular daily report of the operations, which will really give the basis for the argument, there is no objection to having this in evidence as an argument.

MR. KREMER: That is really a matter for cross examination, it seems to me.

THE COURT: What is this but a daily report?

MR. KREMER: So it is; the details of that daily report are subject to cross examination.

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THE COURT: It is nothing more nor less than a gathering together of the figures which appear elsewhere scattered through the various reports presented by the witness.

MR. SCOTT: Exactly.

THE COURT: Of course it adds nothing to the force of his testimony, but it is simply a handy and convenient way of gathering them together, I take it.

MR. WILLIAMS: It is a selection and computation, especially arranged from that record, not to the fundamentals of mill operation, but simply the presentation of an argument; and if this is supplemented by a report giving the information in the same detail that it appears in exhibit 29, there is no objection to having it in evidence.

THE COURT: Isn't that already in evidence?

MR. KREMER: It is already in.

MR. WILLIAMS: No, not the details of it.

Q. 20. THE COURT: As I understand it, this document shows—proposed exhibit No. 191 shows that on the 1st of November, 1916, you used 8.06 lbs. of oil, and on that day the pulp contained solids 46.03?

A. Yes, sir.

Q. 21. And so on?

A. Yes, sir. The first four columns, the figures are copied directly from the original record, and the remainder of the columns with the exception of the sixth one, are computations based on these figures. May I explain that further?

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Q. 22. Yes, you may explain.

A. The first four columns are copied directly from the original record, the pounds of oil per ton, the per cent. of solids, the ore treated per 24 hours, the assay for copper and all are copied from this original statement covering the operations of the vanner concentrate plant for the month of November.

MR. KREMER: It is now in evidence?

MR. SCOTT: No, it is not in evidence.

MR. KREMER: Then I made a statement that, that was wrong.

A. (Continued) The next column which is headed "Percent Cu2S is derived from the preceding column.

Q. 23. BY THE COURT: What is Cu_2S?

A. That is copper sulphide in the form of chalco~~s~~cite, and that figure, 4.51, is derived from 3.60 in the preceding column, that is, converting the metallic copper into sulphide, in the form of chalco~~s~~cite. which is the form in which our copper exists.

Q. 24. BY MR. SCOTT: You mean that the first figure in that column is the copper as metal?

A. Yes, sir.

Q. 25. And in the next column you combine that copper with the sulphur that occurs with it?

A. Yes.

Q. 26. And that column gives the weight of the mineral in which the copper occurs?

A. Yes. Now, the next column which is headed, "Assay Percent Iron 17.8" that is also copied directly from this statement. Now, the next column is the

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percent iron which exists as FeS_2, which is iron pyrite, or a sulphide form of iron. Then the next column is the percent of computed sulphide in metallic iron. You see the 14.4 is computed from the 6.7. One column is the metallic iron and the next column is the iron pyrite, and then the last column, 18.9 that is the sum of 14.4, which is the iron sulphide, and 4.51, which is the copper sulphide.

Q. 27. BY THE COURT: You can furnish or have accessible to the opposing party, the daily records from which this is made up, can you?

A. Yes, sir.

MR. GARRISON: If your honor please, may I call attention to a matter that is seriously embarassing to us. We are only furnished with one copy of these papers, which Mr. Williams has to have, and all these explanations are lost to us because the experts have no copy, and it seems to me that we ought to have two copies of these papers so that our practical men might have them.

THE COURT: Well, I see—You can have this one that I have, because I don't know that it aids the court very much; the court follows the testimony. Both sides ought to be as agreeable as possible and accommodate both parties so they can follow the testimony.

MR. SCOTT: It is unfortunate we have no more copies.

MR. KREMER: We have no more on our side.

MR. GARRISON: You had an extra one to give to Professor Beach that might have come to us.

MR. KREMER: Professor Taggart has one from which he is going to testify presently. I myself have none.

MR. GARRISON: I think the court could make a ruling that they furnish two copies of these papers to each side.

THE COURT: It should be done. The court can only say what should be done in future. You had better deprive your own expert of one and let the others have it. Your own expert will have plenty of opportunity to look at it in time.

MR. KREMER: If your honor please, I made the statement that this was in the record in tabulated form. That is not correct. Mr. Williams interrogated the witness on cross examination about this particular month, and in that way the major portion of the first four columns came into the record.

THE COURT: The objection will be overruled.

Plaintiff excepted.

Tabulation referred to admitted in evidence marked DEFENDANT'S EXHIBIT No. 191.

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CROSS-EXAMINATION.

BY MR. WILLIAMS:

X Q. 28. I note that in the first items of exhibit 191, the assay of the iron is 17.8. The percentage of iron as FeS2, or sulphide of iron, is 6.7. In what condition does the remainder of that iron, the difference between 17.8 and 6.7, exist in the material described?

A. Principally as magnetite, which is an oxide of iron.

X-Q. 29. And does magnetite enter into the froth to any substantial extent?

A. Very little.

X-Q. 30. You would not consider magnetite, which is the magnetic oxide of iron, as a substance of a metalliferous character, that is, having a metallic luster and responding to the condition that float sulphides?

A. It is not a sulphide and does not respond to the treatment which ordinarily floats sulphide.

X-Q. 31. You don't float much of your magnetite?

A. No, sir; we try not to, and it floats to a very, very limited extent.

X-Q. 32. Then, as I understand you, the last column shows what may be termed the metalliferous mineral contained in the material?

A. It is intended to be the total sulphide content of the material treated.

X-Q. 33. What is there in that material besides the 18.9% sulphides; you have stated the magnetite.

A. Yes. There is a little oxidized iron, but very little, and then the remainder is gangue.

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X-Q. 34. Any hydrated iron oxide?

A. I don't know the condition of the iron that exists in there in solution.

X-Q. 35. As I remember it, when I cross-examined you, you showed me a table of the daily operations for the month of November, did you not?

A. Yes, sir.

X-Q. 36. May I look at that table for November, 1916?

A. Yes, sir; this is the one that you wanted a copy of.

X-Q. 37. Will you supply a copy of that table to me?

A. Yes, sir, I will be glad to.

MR. WILLIAMS: That is the document that I wanted to have, your honor, for the purpose of comparison.

X-Q. 38. Will you supplement that by a description of the materials used under the head "Pounds Used of Reagents." That, as I understand it, is the other reagents other than those described in other parts of the column—or have you that information at hand?

A. I have not that information at hand, Mr. Williams.

X-Q. 39. How long will it take you to get it?

A. Probably five or six days.

X-Q. 40. Will you obtain it and let me have it.

A. Yes, sir, I will endeavor to get it for you.

X-Q. 41. Now, you have made a statement that the oil increases with the increase of the sulphides. Upon what experience do you base that conclusion?

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A. Well, that is something that has been clear in my mind for a considerable length of time, because of my familiarity with flotation operations, and it might be particularly illustrated by the large difference in the oil consumption between ~~our~~ the palnts which are treating high grade material, such as this vanner concentrate plant which is under discussion—and the other plant which treats the low grade or vanner tailings. For instance, if we are using the Barrett No. 4 creosote oil in both plants, the oil consumption is very considerably greater in the plant which treats the vanner concentrates than it is in the plant which treats the vanner tailings.

X-Q. 42. Is that the sole foundation for your belief, aside from what these tables show that you have just produced?

A. Well, it has been a matter of observation for a long time; I have believed it to be true for the greater part of my experience in flotation.

X-Q. 43. You gave a great variety of variation of conditions which affected the operation of the plant. They all contribute more or less, I suppose, don't they?

A. Yes, they do all contribute to the results or lack of results that one is able to obtain from the plant.

X-Q. 44. As a matter of fact the man who runs the plant does not need to bother his head with these various considerations that you are talking about?

A. You mean the operator of the machine?

X-Q. 45. The operator.

A. Yes, he is expected to get results, and he has to take care of those things.

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X-Q. 46. How do you instruct him to regulate the plant?

A. We instruct him to get results?

X-Q. 47. How is he to get them?

A. By experience and by training, which is obtained from the men ahead of him, and of course by consultation with his foreman, and with the metallurgical deparment and with myself.

X-Q. 48. What is the principal thing that guides him in his judgment?

A. The assay of the tailings and the assay of the concentrates.

X-Q. 49. He does not get the assay of the tailings and the concentrate at the time that he has to make the adjustment, does he?

A. He gets the assay of the tailings every two hours; they take samples every two hours of the tailings and make assays, as a guide. The assay of the concentrate is made only from shift to shift; so that he gradually learns by experience and the appearance of the froth which runs a certain grade of copper.

X-Q. 50. Isn't it a fact that the appearance of the froth is the principal thing that guides him in his manipulation of the plant?

A. No, I think not.

X-Q. 51. Don't you think that he gets the appearance of the froth, and then he learns from the assays what that appearance means, and then he is guided largely by the appearance of the froth?

A. Well, I think he is guided more by the assay of the tailings than any other thing.

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X-Q. 52. And you get that information two hours after the trouble has happened?

A. No; a sample is taken every two hours, and it probably takes thirty minutes or such a matter, to get the assay after the sample is taken.

X-Q. 53. What experience have you had in running the plant?

A. In running the plant itself? Considerable.

X-Q. 54. And have you made these various adjustments?

A. Yes, sir, personally.

X-Q. 55. And have you always waited for assays before you made the adjustments?

A. Not always.

X-Q. 56. You have usually been guided by your judgment of the appearance of the froth, haven't you?

A. I am guided chiefly by the looks of the froth in the machine. The conditions are repeated to get the bulk of the mineral in certain cells of the machine. If the conditions are not right you get a large proportion of the mineral toward the lower end of the machine and consequently more of it is carried into the tailings.

X-Q. 57. And that I should say was the relative froth appearance in the different boxes?

A. Well, I think it might be more properly stated as the volume of the froth rather than the appearance of it.

X-Q. 58. Examining this table, exhibit 191, I find that on November 28th you used 18.41 pounds of oil and your total sulphides were 34.6. On November 27th you used 17.85 pounds of oil and your total sulphides

were 44.9. Does this seem to your mind to show that the amount of oil increases with the increase of sulphides?

A. I am rather inclined to think, Mr. Williams, that that assay of iron on the 27th is wrong, but the records showed that and so that is what I put in. However, it appears to be a very erratic point. In explanation of that I might say that the concentrate for that day contained 33.5 per cent of iron which was very considerably greater than any other single day during the month.

X-Q. 59. The last figure that you have given me was taken from the detailed statement which you are going to put in evidence later? Is that right?

A. Yes, sir.

X-Q. 60. Did you have mill experience at the Butte & Superior Copper Company?

A. Yes, sir.

X-Q. 61. Your ore there was a great deal richer, wasn't it?

A. Yes, sir.

X-Q. 62. When you were there how was the ore running?

A. Well, it was varying considerable. I think it went up as high as 22 per cent zinc at times, but it was very unusual.

X-Q. 63. I note that in exhibit 158, in the first quarter of 1913, the pounds per ton of oil were 4.76 and the pounds per ton of acid were 1.68 and that the apparent recoveries were 65.34 per cent. That is a very poor operation, wasn't it?

Frank R. Wicks.

A. I haven't that statement, Mr. Williams.

X-Q. 64. You just verified it?

A. I know I have but I can't recall those figures.

(Question read.)

A Yes, sir, that is very poor.

X-Q. 65. And that is an operation with too much oil and too little acid, wasn't it?

A. I am inclined to think that it was not due to too much oil because the next quarter the amount of oil nearly doubled and the recovery went up twenty per cent.

X-Q. 66. And the amount of acid was more than double, wasn't it?

A. Yes, sir.

X-Q. 67. And then in the next quarter the amount of oil was reduced to a still lower point, 4.14; the amount of acid was increased to 7.05 and the recovery went up to 86.49. Then you were increasing the acid, reducing the oil and increasing the recovery? Isn't that right?

A. Yes, sir.

X-Q. 68. And then the fourth quarter the oil was slightly increased, 4.78, the acid was still more increased 8.45, and the recovery went down to 84.97, although not very much. There we find a slight increase of oil, an increase somewhat greater in acid, and a slight falling off on the recovery. Doesn't that indicate that you were getting in these two quarters, nearer to good conditions by diminishing the oil and increasing the acid?

Frank R. Wicks.

A. Yes, it would appear that way from this statement. I think, however, that at least a portion of the improved results were due to improving mechanical conditions.

X-Q. 69. Now, how long did you stay with the Butte & Superior?

A. Until April, 1915.

X-Q. 70. And it was during the year 1915 that the oil was brought down to 1.49 pounds per ton; the acid maintained practically at 7.81 pounds per ton and the apparent recovery was up to 90.18 per cent per ton. That was a very great improvement, wasn't it?

A. Yes, sir, it was a very considerable improvement.

X-Q. 71. And that result was obtained with an ore vastly richer in metalliferous mineral contents than any of the ores that you referred to in this table, exhibit 191, was it not?

A. Yes, but an entirely different ore.

X-Q. 72. I won't ask you about metalliferous con tent of that ore because Mr. Dosenbach will furnish it. I suppose you haven't anything at hand that will give it?

A. No, I haven't that figure. I can say, however, that our records that were kept at that time, while I was there, were correct within the best of my knowledge.

WITNESS EXCUSED.

EDWARD W. ENGLEMAN, recalled for further direct examination, testified as follows:

DIRECT EXAMINATION.

BY MR. SCOTT:

Q. 1. Mr. Engleman, is it not true that in the operation of your flotation plant the following factors are liable to variation: first, the tonnage fed to the plant per unit of time, 24 hours being the usual unit employed?

A. It is.

Q. 2. Is the kind of oil used subject to variation?

A. Very slight variation.

Q. 3. At your plant?

A. Yes, sir.

Q. 4. And the duration and degree of agitation and aeration?

A. Fairly constant.

Q. 5. How about the kind and quantity of reagents, other than oil?

A. We don't use any.

Q. 6. You dont' use any at all?

A. No.

Q. 7. How about the temperature of the pulp?

A. Does not change.

Q. 8. The percentage of moisture in the feed?

A. Varies slightly.

Q. 9. The percentage of sulphide in the feed?

A. Varies slightly.

Q. 10. The quantity of oil used?

Edward W. Engleman.

A. Varies slightly.

Q. 11. Now, in your plant when using the minimum efficient quantity of oil, if all conditions above that I have just mentioned remain constant except the percentage of water in the feed and the quantity of oil used, what change do you make when the percentage of water in the feed increases?

A. Increase the oil.

Q. 12. Now, in your plant when using the minimum efficient quantity of oil if all conditions remain constant except the percentage of sulphide in the feed and the quantity of oil used, what change do you make when the percentage of sulphide in the feed increases?

A. Increase our oil.

Q. 13. I think you have compiled some tabulations from your records, haven't you, showing the relation between percentage of sulphide and oil, quantity and per cent of water and oil quantity?

A. I have.

Q. 14. Are these compiled from the original records?

A. They are.

Q. 15. And to your knowledge they are correct statements of the matters set forth?

A. They are.

Q. 16. Do they cover the two departments of your mill, the vanner concentrate and the slimes plant both?

A. Yes, I have tabulations here for the entire year of 1916 on our retreating plant feed and the same period on our slimes vanner tailing feed.

Edward W. Engleman.

Q. 17. And if requested to you can supplement these tables by additional information from the records you have with you?

A. Yes, sir.

MR. SCOTT: I offer this tabulation in evidence, one entitled "Ray Consolidated Copper Company, Hayden plant, data compiled from monthly statements form number 62R, showing results of operation of vanner concentrate retreatment plant during the year 1916."

Tabulation admitted in evidence and marked DEFENDANT'S EXHIBIT 192.

MR. SCOTT: And the second tabulation entitled "Ray Consolidated Copper Company, Hayden plant, data compiled from monthly statements, form 62R, showing results of flotation operation for ten-day periods during the year 1916." "Slimes vanner tailing plant."

Tabulation admitted in evidence and marked DEFENDANT'S EXHIBIT 193.

Edward W. Engleman.

CROSS-EXAMINATION.

BY MR. WILLIAMS:

X-Q. 18. Taking up exhibit 192, what does the last column show?

A. Per cent total copper and iron in feed.

X-Q. 19. And those are the only two minerals that are represented in the metalliferous mineral?

A. Practically so.

X-Q. 20. To any substantial extent?

A. Yes, sir.

X-Q. 21. So that instead of showing the sulphide you merely show the minerals that are represented in the sulphide; in this table?

A. Yes, sir.

X-Q. 22. Why didn't you show the sulphides?

A. Because I have these assays for every day of the operation during that year and they are reported as copper and iron and not as iron sulphide.

X-Q. 23. Now, this last column is the sum of the two columns before it? Is that right?

A. Yes, sir.

X-Q. 24. Now, these pounds of oil per ton, how do you figure that?

A. Pounds of new oil added per ton of feed treated.

X-Q. 25. And this first column represents—is that "dates"—can't be dates of course?

A. This statement is made up of ten-day periods and period No. 1 is therefore the first ten days and period No. 2 represents the second ten days.

Edward W. Engleman.

X-Q. 26. Where does this start?

A. January 1st, 1916.

X-Q. 27. And does it run consecutively?

A. Yes, sir.

X-Q. 28. And this last period 36?

A. That is December 20th to 30th, or 31st.

X-Q. 29. December what?

A. It is the last ten days in December, 1916.

X-Q. 30. Now, let us take the other one, 193, I don't read on this statement what it is.

A. Slime vanner tailings plant, I think you will see it up there.

X-Q. 31. It is written in ink?

A. Yes, sir.

X-Q. 32. Does that commence with January 1, 1916?

A. It does.

X-Q. 33. I notice that the fourth item of the fourth horizontal line is shown in blank. What is the reason for that?

A. The fourth item and also the 20th item are blank. I could not find the ten day reports for that, but I have the daily operations which go to make up that ten day report and I did not have time to figure it in order to tabulate, but I have it.

X-Q. 34. Will you supply that deficiency in order to complete the record?

A. Yes, sir.

X-Q. 35. That applies to all of the blanks, these two sets of blanks, does it not?

A. Yes, sir.

X-Q. 36. Now, as to the other one, the vanner concentrate retreatment plant, I notice that there are some blanks?

A. The last blank or period 36, I did not tabulate that because on the last day of December in this plant we added over one per cent of oil and it would not be fair to add that in that tabulation.

X-Q. 37. But the other blanks you can supply just as you did before?

A. Yes.

X-Q. 38. I wish you would do so.

A. All right.

MR. WILLIAMS: I think with the same reservation—of course I have not had time to study these—I will suspend the cross-examination.

WITNESS EXCUSED.

J. T. SCHIMMIN, called as a witness in behalf of the defendant, being first duly sworn, testified as follows:

DIRECT EXAMINATION.

BY MR. SCOTT:

Q. 1. Will you please state your full name?

A. J. T. Schimmin.

Q. 2. What is your occupation?

A. Mill superintendent for the Butte & Superior Mining Company.

Edward W. Engleman.

Q. 3. And how long have you had experience with flotation concentration?

A. Since in September, 1912.

Q. 4. In the operation of the Butte & Superior flotation plant I will ask you whether the following factors are liable to variation: first, the tonnage fed to the plant per unit of time?

A. Yes.

Q. 5. And how about the kind of oil?

A. Yes.

Q. 6. That varies too?

A. Yes.

Q. 7. And is there any variation in the duration and degree of agitation and aeration?

A. Yes.

Q. 8. Is that variation marked, the speed of agitation?

A. Yes, it is.

Q. 9. Over what periods does it vary—vary from higher to lower I mean?

A. Oh, no, the amount of agitation does not vary. It is constant.

Q. 10. The agitation and aeration are constant?

A. Yes, they are constant.

Q. 11. The kind and quantity of reagents other than oil? Is there some variation in that?

A. But very little.

Q. 12. Temperature of the pulp?

A. Very little variation in the temperature.

Q. 13. And is there some variation in the percentage of moisture in the feed?

Edward W. Engleman.

A. Yes, at times there is.

Q. 14. And how about the variation in the percentage of sulphide in the feed?

A. Yes, that varies to a certain extent.

Q. 15. And how about the variations in the quantity of oil used?

A. Well, that varies slightly, depending upon the tonnage and so forth.

Q. 16. Now, in your plant when using the minimum efficient quantity of oil, if all the conditions I have just mentioned remain constant except percentage of water in the feed and the quantity of oil used what change do you make when the percentage of water in the feed increases?

A. We increase the oil.

Q. 17. Now, in your plant when using the minimum efficient quantity of oil if all conditions remain constant except percentage of sulphide in the feed and the quantity of oil used what change do you make when the percentage of sulphide in the feed increases?

A. Increase the oil.

Q. 18. Have you compiled a tabulation from your records showing the relations between percentage of sulphide and oil, quantity and per cent of water and oil quantity?

A. I have, yes, sir.

Q. 19. Did you compile this or have it compiled under your direction?

A. I have had it compiled under my direction.

Q. 20. From the original records of the company?

Edward W. Engleman.

A. Yes.

Q. 21. And you are able to testify that this is an accurate statement of the matters set forth?

A. Yes.

Q. 22. And you do so?

A. Yes.

MR. SCOTT: I offer this tabulation entitled "Butte & Superior Mining Company, data compiled from original records of flotation plant operations, month of November, 1916, flotation plant feed."

Tabulation admitted in evidence and marked DEFENDANT'S EXHIBIT 194.

MR. SCOTT: You may cross-examine.

CROSS-EXAMINATION.

BY MR. WILLIAMS:

X-Q. 23. In the second column in the tabulation produced by you, exhibit 194, the first column following the date, the first item is 1.67 pounds of oil per ton?

A. Yes.

X-Q. 24. Is that new feed?

A. That is new flotation feed, yes; new feed.

X-Q. 25. And what oil was used then?

A. Pine oil.

X-Q. 26. And throughout the month of November that is here tabulated what oil was used?

A. Pine oil with the exception of—I don't remem-

ber exactly—it was about 36 hours I think when reconstructed oil, compounded oil, was used.

X-Q. 27. Can you tell me when this was, these operations, because having a new and totally different oil introduced it might introduce a variable factor?

A. No, I can't tell you the exact date without looking it up.

X-Q. 28. Will you look that up?

A. Yes.

X-Q. 29. Of course that would take a day and a half and might seriously change one of these figures; you appreciate that?

A. Yes.

X-Q. 30. What other reagent or reagents were used during this period of November, 1916?

A. Sulphuric acid and copper sulphate solution.

X-Q. 31. Was the amount of sulphuric acid and copper sulphate solution variable during this period?

A. Slightly, yes.

X-Q. 32. To what extent did it vary? Take first the sulphuric acid?

A. Well, it would probably vary from six and a half to eight and a half pounds per ton.

X-Q. 33. And how the copper sulphate?

A. Probably two one-hundredths of a pound of metallic copper, equivalent to two one-hundredths of a pound of metallic copper.

X-Q. 34. And how about its variation?

A. That is the variation.

X-Q. 35. What was the absolute assay then?

Edward W. Engleman.

A. From eight one-hundredths of a pound to one-tenth of a pound.

X-Q. 36. Now, I notice that you have compiled the zinc sulphide from the assay of zinc. It is true, is it not, that there are small quantities of other sulphides in your ore?

A. Yes.

X-Q. 37. And these other sulphides are variable, are they?

A. The sulphides vary but little. In fact, you might call them almost constant.

X-Q. 38. And what would be the constant or nearly constant, approximately, that would have to be added to the zinc sulphide to represent the total sulphides in the ore?

A. You mean the percentage that should be added to represent the total?

X-Q. 39. Yes.

A. I should say between six and seven per cent.

X-Q. 40. Have you a tabulation covering this month giving the other factors such as appear on the large sheet containing the Butte & Superior operations which has been put in evidence? Have you a table of that character?

A. Yes, I haven't got it with me though.

X-Q. 41. Will you produce it and let me have it?

A. Yes, I will.

MR. WILLIAMS: The cross-examination is suspended.

WITNESS EXCUSED.

Ralph Augustus Conrads.

R. A. CONRADS, recalled, testified as follows:

DIRECT EXAMINATION.

BY MR. SCOTT:

Q. 1. Mr. Conrads, will you tell me whether in the operation of the flotations plant where you are employed the following factors are liable to variation: tonnage fed to the plant per unit of time?

A. Yes, sir.

Q. 2. That is subject to variation?

A. It is subject to variation.

Q. 3. How about the kind of oil used? Is that also a variable?

A. The kind of oil used is variable to a degree. That is we have certain standard oils which we ordinarily use, but at times we are forced to make changes, though we do not make any radical changes in that ordinarily.

Q. 4. Is there much or any variation in the degree of agitation or aeration?

A. No, that is fixed with us.

Q. 5. And the variation in kind and quantity of reagents, other than oil?

A. There is a variation in the quantity, but not in the kind, there is not.

Q. 6. How about the temperature of the pulp?

A. We run at atmospheric temperature. We don't artificially heat the pulp.

Ralph Augustus Conrads.

Q. 7. You don't use artificial heat?

A. Do not.

Q. 8. So it is subject to variation from any sources whatever other than the climate?

A. It is subject to slight variations, but it is not noticeable or hardly considerable.

Q. 9. Does the percentage of moisture in the feed vary?

A. It does, yes.

Q. 10. Percentage of sulphide in the feed?

A. That also varies.

Q. 11. Quantity of oil used?

A. And the quantity of oil is variable.

Q. 12. Now, in your plant when using the minimum efficient quantity of oil and all conditions that I have just mentioned remain constant except percentage of water in the feed and the quantity of oil used, what changes do you make when the percentage of water in the feed is increased?

A. Increase the amount of oil.

Q. 13. In your plant, while using the minimum efficient quantity of oil and all conditions remain constant except percentage of sulphide in the feed and quantity of the oil used, what changes do you make when the percentage of sulphide in the feed increases?

A. We increase the oil also.

Q. 14. You have made a tabulation, have you, from your records showing the relation between percentage of sulphide and oil quantities, and percentage of water and oil quantities?

A. Yes.

Q. 15. During the period covered by this compilation was the same character of oil used throughout?

A. There was a certain variation. I made one chart which covered the entire period of the plant during which they have treated or retreated low-grade concentrate, the kinds of oil have varied in that, and I have taken these monthly averages and made a compilation on that basis. I have another in which the kinds of oils were not varied a great deal. It is practically a crude mineral oil with creosote. That is for a 28-month period, September, 1914, to December, 1916, inclusive.

Q. 16. You compiled this yourself from the original records?

A. I did, yes, sir.

Q. 17. And it is correct?

A. To the best of my knowledge it is correct.

MR. SCOTT: I will offer this tabulation entitled "Utah Copper Company, Magna Plant, Metallurgical Department, data compiled from statements giving average results by months of operations of vanner concentrate flotation plant, September, 1914, to December 1st to 24th, inclusive, 1916."

Tabulation admitted in evidence and marked DEFENDANT'S EXHIBIT 195.

Q. 18. You also compiled this second statement which you handed to me?

A. I did.

Ralph Augustus Conrads.

Q. 19. And is it correct and accurate?

A. To the best of my knowledge and belief, it is.

MR. SCOTT: I offer the second report produced by the witness, entitled "Utah Copper Company, Magna Plant, Metallurgical Department, data compiled from original records of operation of vanner concentrate flotation plant for the year 1915, etc."

Table admitted without objection, marked DEFENDANT'S EXHIBIT 196 (two sheets).

Q. 20. You compiled this third statement from the original records, did you?

A. Yes, I did.

Q. 21. And is it true and accurate?

A. Yes, to the best of my knowledge and belief it is.

MR. SCOTT: I offer the third statement produced by the witness, entitled "Utah Copper Company, Magna Plant, Metallurgical Department, date compiled from original records of operation of vanner concentration flotation plant for the year 1916."

Table admitted in evidence marked DEFENDANT'S EXHIBIT No. 197 (2 sheets).

MR. SCOTT: Mr. Conrads wants to correct an answer that he made before, Mr. Williams.

Q. 22. What was the answer?

A. There is just one question; in reading over my former testimony, in that, while my answer is correct, it is not quite as accurate as I would like to put it, and I would like to make the correction accordingly.

MR. WILLIAMS: You may do so. Will you give me the number of the answer?

THE WITNESS: Yes, sir; it is page 560, question No. 306. You asked: "That sludge tank, is that full—full to overflowing?" and my answer was "No, I have never seen the sludge tank full; that is, it is a perfectly clean fall; that is, it does not interfere in getting the samples." I want to correct that statement simply in this, that I have a very few times seen that sludge tank overflowing a little froth. Now, if you will look at the previous questions, we were considering the matter of sampling the circulating feed, and where that sample is got, and when you asked the question I had in mind the sampling, and my answer there was with that in mind. I have never seen the sludge tank full of pulp, and very few times have I seen it overflowing froth, and we are very careful in taking that sample that it is never full, so as to interfere with the sampling of the stream as it drops from the launder into the tank. I wanted to be a little more accurate in that, as I noticed that, while practically true, it was not as accurate as I wished it stated. That is all, Mr. Williams.

Ralph Augustus Conrads.

CROSS-EXAMINATION.

BY MR. WILLIAMS:

X-Q. 23. Now, in the first of these tables which you produced, exhibit No. 196, you gave the variation in the kind of oil; in this period, covering from January 12th, 1916, to December 23d, 1916, you made, of course, certain variations in the oil, did you not?

A. There were some variations, yes, sir.

X-Q. 24. Do you think you have previously testified as to what those variations were?

A. Well, I gave you, if you will remember, a note of the variations asked for, and, as I stated in my direct examination, there were no extreme or radical variations. We used through that time, practically all of the time—I think I am safe in saying all of the time—crude petroleum oil with creosotes. Now, those creosotes were varied to a certain degree, though not radically.

X-Q. 25. And all of those creosotes, of course contained soluble constituents?

A. Yes, sir.

X-Q. 26. And the other oil, the crude petroleum oil?

A. It is a top petroleum oil, that is, a crude oil with the lighter groups removed; practically all the gasoline and kerosene are removed.

X-Q. 27. Did you ever determine whether or not there were any soluble constituents in those oils?

A. No, but from the very nature of them, it is safe to say that there would be practically none.

X-Q. 28. Could you give me any figures as to the percentage of soluble constituents in the creosote?

A. No, I could not.

X-Q. 29. Now, the second table that you have produced, exhibit 197.

A. That is the third table, Mr. Williams.

X-Q. 30. Well, the one that I am referring to is No. 197, data compiled from the original records of the operations of the vanner concentrate flotation plant for the year 1916.

A. There are two of those for that year. Exhibit No. 196 covers the days in the year 1916 on which the percentage of solids in the flotation feed was not under 31% nor over 33%, while in exhibit 197 the compilation embraces the days of the year on which the percentages of mineral—that is, 100% minus the per cent of the insoluble matter, in the feed, was between 24.5 and 25.5.

X-Q. 31. Are these the assay returns of the insoluble that you give in this table, exhibit 197?

A. Yes.

X-Q. 32. And is it true of your ore that the assay returns of insolubles give all of the constituents except the sulphides?

A. No, but I took that for the reason that, on account of the nature of our ore, I think that this will more nearly represent it—that is, represent the total amount or percentage of mineral than by attempting

Ralph Augustus Conrads.

to calculate it from the copper and iron of the assay.

X-Q. 33. What are the constituents of your ore? which are present in the form of sulphides?

A. Principally pyrite, chalcopyrite and chalcocite, with certain other minerals entering into it in a minor degree. The reason that I did not calculate them on the basis of the assay for copper and iron was because the ratio of the amount of chalcocite and chalcopyrite and pyrite, for example, are not constant from one day to another or from one time to another.

X-Q. 34. Is the ratio of sulphide—or is the proportion of sulphide clearly indicated by the amount of insoluble in the assay returns?

A. It is not absolutely accurate, though I believe that it is a more accurate way of getting that ratio than any other that I know of, without analyzing, and every one specially, which analyses we do not have.

X-Q. 35. That is, with the assays before you, you selected this as the one that would give us the nearest estimate of the proportion of metalliferous mineral in the ore; is that correct?

A. The proportion of sulphide or metalliferous mineral in the ore, yes, sir. While that is not absolutely accurate, I take it because I think it is the most nearly accurate of any way that we have at hand.

X-Q. 36. Now, will you give me a typical assay, so that we can see all the conditions that entered into your determination?

A. You mean to take one of these days and give you the assays?

X-Q. 37. Yes.

A. What day would you like, Mr. Williams?

X-Q. 38. Take about the middle of the period. I don't see the months.

A. The month is indicated by the first figure ~~degree~~ of the two in the left-hand column.

X-Q. 39. Well, we will take about the middle of July. About 6/24—June 24th will answer.

A. June 24th. The heading on that day assayed 6.64% copper, 6.54% iron and 75.10% insoluble. The per cent of solids is on the sheet at 29.65, and the pounds of oil per ton were 3.40.

X-Q. 40. And that is all your assay shows?

A. In the heading, yes, sir.

X-Q. 41. You might complete it by giving me the assay of the concentrates and of the tailings on that day.

A. The concentrate assayed 25.98% copper, 23.25% iron and 16.13% insoluble. The tailing assayed .35% copper and .76% iron.

X-Q. 42. Percentage of insoluble, have you that in the tailing?

A. No, sir; we never run the tailing for insoluble.

X-Q. 43. Now, let us take September 1st.

A. September 1st, 1916; the heading was 7.68% copper, 6.08% iron and 74.70% insoluble. The concentrate, 29.12% copper, 20.62% iron and 18.43% insoluble; tailing, .24% copper, and .51% iron.

X-Q. 44. Now, let us take the last date, December 18th.

A. December 18th, the heading assayed 7.60% copper, 5.78% iron and 74.93% insoluble; the concentrate, 30.95% copper, 20.32% iron, 16.60 insoluble; and the tailing, .138% copper and .56% iron.

MR. WILLIAMS: The cross-examination of Mr. Conrads will be suspended for the present until we have further studied the tables.

FRANK JANNEY, after being duly sworn as a witness for defendant, testified as follows:

DIRECT EXAMINATION.

BY MR. SCOTT:

Q. 1. State your full name.

A. Frank G. Janney.

Q. 2. What is your occupation, please?

A. General superintendent of mills for the Utah Copper Company.

Q. 3. The mills at Garfield, Utah?

A. At Garfield, Utah.

Q. 4. They are known as the Magna plant and the Arthur plant, are they not?

A. They are.

Q. 5. How long have you been occupied in practising flotation, or how long does your knowledge of flotation extend?

A. Since the early part of 1912.

Q. 6. And you have been continuously engaged in

the practice or trying out of flotation processes ever since?

A. I have.

Q. 7. Will you state whether it is true that in the flotation process the following factors are liable to variation; first, the tonnage fed to the plant per unit of time.

A. Yes.

Q. 8. And how about the kinds of oil used?

A. They are variable.

Q. 9. You might state to what extent that is variable, and what kind of oil is used generally.

A. Well, they are variable simply in the kind, that is all.

Q. 10. How about the duration and degree of agitation and aeration?

A. It is constant.

Q. 11. And the kind and quantity of reagents other than oil?

A. Variable.

Q. 12. And the temperature of the pulp—of course I refer to your own operations.

A. I understand. We operate at atmospheric temperature.

Q. 13. And percentage of moisture in the feed?

A. Variable.

Q. 14. The percentage of sulphide in the feed?

A. Variable.

Q. 15. How about the quantity of oil that you use?

A. Variable.

Frank G. Janney.

Q. 16. Now, in your plant, when using the minimum efficient quantity of oil, if all the conditions we have just mentioned remained constant, except percentage of water in the feed and quantity of oil used, what change do you make when the percentage of water in the feed increases?

A. Increase the oil.

Q. 17. And in your plant when using the minimum efficient quantity of oil, if all factors remain constant except percentage of sulphide in the feed and quantity of oil used, what change do you make when the percentage of sulphide in the feed increased?

A. Increase the amount of oil.

Q. 18. Have you visited several different flotation plants and observed their operation?

A. I have.

Q. 19. Are you familiar with the way in which these flotation operators generally tell when they need to change the quantity of oil—when the quantity of oil should be changed?

A. I am in a general way.

Q. 20. In a general way what does occasion their adjustment of the oil quantity?

A. The dilution.

Q. 21. Any other thing?

A. The agitation and the amount of sulphide.

Q. 22. You have made some tables, haven't you, of the operations conducted under your charge, showing the relations between percentage of sulphide and oil quantities and percentage of water and oil quantities?

A. I made one tabulation of the variation of the pounds of oil to percentage of sulphides only.

Q. 23. Is this tabulations made from your original records?

A. It is.

Q. 24. And you have personal knowledge that it is correct?

A. I have.

MR. SCOTT: I offer this tabulation entitled "Utah Copper Company, Arthur Plant, metallurgical department, data compiled from original record of operation of flotation plant treating original slime feed."

Tabulation admitted in evidence and marked DEFENDANT'S EXHIBIT 198.

Q. 25. Will you just explain, Mr. Janney, what this tabulation is intended to exhibit?

A. This tabulation was gotten up from which a graphic chart was drawn and refers only to the pounds of oil per ton and the percentage of solids. The copper and iron values having no value in the graphic charts.

Q. 26. You mean the graphic chart which was made?

A. From this data.

Q. 27. Was data only on the dilution?

A. The same thing.

Q. 28. And no account was taken of the mineral?

A. No.

MR. SCOTT: You may cross-examine.

Frank G. Janney.

CROSS-EXAMINATION.

BY MR. WILLIAMS:

X-Q. 29. As I understand it this chart that you have produced represents proceedings with an invariable oil mixture, is that right?

A. Invariable oil mixture.

X-Q. 30. Now, what was that oil mixture?

A. 95 per cent Barrett number 4, 5 per cent Yaryan pine.

X-Q. 31. Barrett number 4 is what kind of an oil?

A. Creosote oil.

X-Q. 32. And that had a soluble constituent?

A. It has.

X-Q. 33. And the pine oil is to some extent soluble, in the proportions used?

A. It is.

X-Q. 34. And other conditions then, thickness ~~rf~~ of pulp and richness of ore, did they have any influence on the increase or diminution of the amount of oil?

A. Change in feed and tonnage.

X-Q. 35. Anything else?

A. No.

X-Q. 36. Of course you are referring to the operations in your plant?

A. Yes.

X-Q. 37. How about the variation in the amount of gangue in the feed; ~~that doesn't~~—doesn't that vary the oil proportions?

A. It does through the dilution.

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X-Q. 38. Aside from the dilution and considering it as a matter of solids, the amount of gangue in the feed is quite an important item in itself, is it not, in varying the amount of oil?

A. I don't know just exactly what you mean.

X-Q. 39. I suppose that may be said to be the reverse of the condition of richness of ore. That is to say if your ore contains more mineral and less gangue, that is one condition?

A. Yes, sir.

X-Q. 40. Now you might have a condition where there was less mineral and more gangue, then the ore would not be as rich?

A. Yes.

X-Q. 41. Now, under these conditions you have to change the oil?

A. Yes.

X-Q. 42. So that to that extent the increase and diminution of gangue is a variable although related to the decrease and increase of metalliferous mineral? That is right, is it not?

A. Yes.

X-Q. 43. Now, how about the character of the gangue? Doesn't that change the oil proportion?

A. Not on our ore.

X-Q. 44. Not on your ore?

A. No.

X-Q. 45. And you refer to the operations of the Arthur plant?

A. Yes.

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X-Q. 46. How about the fineness of the grinding of the gangue? Isn't that a factor?

A. Not on our ore, I do not think.

X-Q. 47. That is to say that is not a variable in your ore?

A. It is not a variable, very constant.

X-Q. 48. You testified, did you not, in the suit of the Minerals Separation Limited against the Miami Copper Company?

A. I did.

X-Q. 49. And in your testimony there you described the great troubles that you had in correcting the faults of the plant of the Butte & Superior Copper Company, the flotation plant, did you not?

A. I did.

X-Q. 50. You might give me the period when you were correcting these faults, generally?

A. From July of 1912 to—

X-Q. 51. (Interrupting.) Just to refresh your memory, what you answered in the Miami case was: "I was sent to investigate the Butte & Superior process in the early part of 1912. I think it was in the month of June or July; maybe May; I will not be positive about that point." I have read your testimony correctly?

A. Yes, sir. I looked it up since then, it was July.

X-Q. 52. And how long did you continue in this struggle which you so fully outlined in the Miami case of getting that plant into good working condition?

A. About the middle of 1913; I am not positive

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when I made my last trip to Butte. I know it was in the year 1913.

X-Q. 53. Reading from your testimony in the Miami case, question 94: "Now, will you tell us the date upon which the results were of such a character as to make it certain that flotation was advantageous? A. It was in the month of April or May of 1913." Have I read your testimony correctly?

A. Yes, sir.

X-Q. 54. And is that a correct statement?

A. It is.

X-Q. 55. I also read you question 95: "And what did you do in the way of oils? A. We tried several different kinds of oil, oleic acid, various grades of oleic acid, pine tars and pine oils and wood tars. Q. 96. Can you make a statement as to the comparative results of using pine oil and oleic acid? A. With pine oil we found that we could get a very good grade, but we were unable to make a good tailing. With oleic acid we could make a very good tailing, but only a fair grade." Have I read your testimony correctly?

A. You have.

X-Q. 56. And that needs no correction, I take it?

A. None at all.

MR. WILLIAMS: That is all.

RE-DIRECT EXAMINATION.

BY MR. SCOTT:

R-Q. 57. Were you in charge of the operations of the Magna plant from September, 1914, down to July, 1915?

A. I was.

R-Q. 58. You are familiar with this tabulation that has been made, I take it?

A. Yes.

R-Q. 59. Are you in a position to verify these reports, state that they are accurate and true?

A. To the best of my knowledge they are.

MR. SCOTT: There is no further objection to these.

MR. WILLIAMS: No further objection upon the ground that the witness is not able to testify to the facts.

(Exhibit 35.)

WITNESS EXCUSED.

PROF. ARTHUR FAY TAGGART, recalled, testified as follows:

DIRECT EXAMINATION.

BY MR. SCOTT:

Q. 1. Professor Taggart, have you made any investigation based on the facts set forth in these compilations which are in evidence as exhibits 191 to 198?

A. I don't know the exhibit numbers. I have made some compilations, some graphs based on the data that has just been presented regarding the relation between the percentage of oil and the dilution of the pulp and the percentage of sulphide in the pulp.

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Q. 2. Well, what conclusions have you arrived at from your investigation?

A. I have arrived at the conclusion that—or at least I have confirmed the conclusion that there is a relation and a very decided and strong relation between the percentage of sulphide in the feed or the variations in this percentage and the variations in the quantity of oil required, other things being constant, and also between the variations in the dilutions of the feed and the quantities of oil required, other things being constant. I am offering this data rather to satisfy Mr. Williams I think in regard to an inquiry in my previous testimony as to whether these statements that I was making were not wholly theory and as to whether it was possible to confirm them with any experimental data. He did not include mill operations, but the mill operations being more closely at hand, I investigated those and I have here a series of charts which show unmistakably a direct relation between the pounds of oil used and the dilution of the pulp, other factors being constant, and the pounds of oil and the percentage of sulphide in the pulp, other things being constant. Now I wonder if I might explain a little bit here regarding the curves compiled from empirical data. If your honor will notice this particular sketch which we will offer later you will see that there are points scattered around over this sheet and that through them I have drawn a curve. The curve does not go through every point but is the average curve of these points. It has been put through according to the

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accepted method of putting curves through points representing the result of investigations and such curves leading, if desired, to the formulation of emperical formulae to represent the relation between the two particular variables investigated. Now, just to show you that every fact represented there does not lie directly on the curve I would like to cite a couple of

P. 3531, L. 9, insert " familiar to all of us and which are " after " are "

temperature with the seasons. For various parts of the country there are well established average curves of temperature ranging from season to season, and if I may represent here about how one of these curves goes I think it will perhaps make it clear. If each one of these divisions represents a particular division of the year as for instance, if this represents February, this March and this April, May, June, July, August, and this represents degrees of temperature, we will call these, we will say forty, fifty, sixty, seventy, and up to eighty, we know that in certain communities at least from February through March, through April and May there is a gradual increase in the temperature which would be represented in some such fashion as this. Suppose that during February the average temperature were 40°; during March the average temperature were fifty degrees, then a point would be placed there, and during April it were 55 degrees, another point would be placed at the ordinate representing May, and if in May it were sixty and

June sixty-five, and July seventy, then the curve that would represent the average would be drawn in actually a straight line for the average through these points. Now, nobody would expect, looking at that average curve that all the days in March were going to have a temperature of 50 degrees. If we plotted along here the temperature of the days in March they would be found to spot around the average in that case; and, similarly, if we plotted the days in April, and it is quite easily recognized that there is an average advance of temperature through these months. Another case, and one upon which a great deal more money is invested than this particular case of temperature, and one in which the ranges are much greater, is the case of life insurance premiums based on the average life, and life insurance premiums have decreased as the years have gone on, due to the fact that the average age of people in certain lines of life is increasing. Now, we know very well that if we draw a curve representing—take one thousand people, and if we draw a curve representing the average age of life that it will not mean at all that certain people are going to live until exactly that age. There are going to be deaths of course from an hour or a shorter moment after birth to even very considerable old age. These are going to range through large distances and yet for each year that those data are compiled there are going to be deaths all through these different ages and yet the average curve through there will show that as we go from 1912 to 1913 and from 1913 to 1914 there

is a gradual increase in the average age; and that average curve is so well recognized that the life insurance companies expend or promise to expend enormous sums of money on the computations made by their actuaries. These computations are merely straight lines, average lines drawn through these experimental points. Now, I hope with this explanation that I may be able to show the results of plotting some of these facts that have just been represented, and to show your honor that the curve drawn through in each particular case represents the average of all these points which are plotted on the graph. The first curve which I have here is that of the Utah Copper Company, Arthur plant, flotation treatment of original slime feed for the months of September and October, 1916, omitting October 8th to 12th inclusive when the oil mixture was changed, the data being compiled from original records of operation, these records being already in evidence, presented by Mr. Janney.

MR. SCOTT: I offer the table just described by the witness.

MR. WILLIAMS: No objection.

The graph admitted in evidence and marked DEFENDANT'S EXHIBIT 199.

A. Now, if your honor will notice this particular curve it increase, that it rises toward the right. If you will notice down at the bottom of this sheet are certain numbers and written above that are the words "pounds of new oil used per ton of original feed," and

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that these numbers increase towards the right. That means a point which was plotted on the chart anywhere above that three, for instance, represents that three pounds of oil were used. That is if a point appears anywhere along this line vertically above the three, it means that three pounds of oil were used. Then, on the left hand margin of the sheet are two series of numbers, those to the left reading 80, 85 and 90, and representing the per cent of water in the feed. They read upward 80, 85 and 90, indicating that that particular square increases upwards. The complimentary square of that is put beside it, that is 10, 15 and 20. The three numbers reading downwards representing percentage of solids in feed. Of course the statement of our constants, if put in terms of percentage of solid in the feed, would be that the pounds of oil necessarily varied inversely as the percentage or solid in the feed; but it is rather easier to speak of the direct variation, rather than of the inverse variation. Now, your honor will notice that as this curve passes to the right it rises and if we take first any point on the vertical line running upwards, this one representing one pound of new oil used per ton of original feed, and then run over to the left at th~~e~~at level, the square representing the percentage of water in the feed, you will see that the percentage of water there is about eighty-two per cent. In other words, for a percentage of water eighty-two per cent of the total pulp fed to the mill an average amount of one pound of oil per ton of solid feed to the mill was used. If now your

honor will go out to the vertical line over the number two on the lower scale and follow that line up to its intersection with the straight line which has been drawn and then follow from that point to the intersection to the left and read on the scale of percentage of water you will see that that reads about eighty-four and a half. In other words when the dilution of the pulp has increased from eighty-two to eighty-four and a half, the average amount of oil necessary in that particular mill had increased to two pounds. There is a direct relation there, other things being approximately constant, between the amount of oil needed and the amount of water present in the pulp. That same thing is borne out in all these other statements, as I will represent the curves to you.

Q. 3. Now, Professor Taggart, would it be practicable to explain, so that we can get some idea of the manner of laying out these curves and what these numbers mean on the different dots?

A. Yes. The numbers I may say on the curves correspond to the numbers in the left-hand column of the particular sheet which goes with it. In other words, those are the data to which these particular dots correspond. For instance, if we take the number 6 at the far left of the chart. The numbers corresponding to this on this sheet are "pounds of oil per ton, 0.82". That is on the sheet entitled "Utah Copper Company, Arthur plant," and there being only one of those.

Q. 4. Is that the last one?

A. The last one that was offered.

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THE WITNESS: Now, if you will look at this No. 6, you will note that the dots to the left there refer to the date of September 6th, and there in the next to the last column is "Pounds of Oil per Ton, 0.82." Now, going to the scale at the bottom of the sheet and moving out here to a point between 0.75 and 1—The point 0.82 represents the distance to the left at which you must plot this 0.6. Now, corresponding with 0.82 there is in the last column the number 19.30, which represents the percentage of solids in the feed; and going then on to the scale at the left end of the chart between 15 and 20 in the column "Percentage of Solids in Feed," down near the 20 in order to get at 19.30,—That is the altitude of this charge at which this same spot should be plotted.

Now, if we follow that horizontally, then, from that point and vertically upward from the point right over 0.82 which we have previously located, at the intersection of those two lines is the point where that figure 6 is to be plotted. In other words, if we work this thing backwards, you take the point 6, and you can read that it means 0.82 pounds of oil were used, and the percentage of solids in the feed was 19.30, and the same method is followed in plotting, as it is called, all these points from the sheet, and all these different values from this sheet of the different dots represented in their proper position by this series of dots on the chart, showing by their number the particular date which they represent—those numbers which are separate being for the month of September, and those which

are preceded by the number 10, representing the different days in the month of October.

This particular chart extends from the first of September to the end of October, 1916.

Now, the method of putting the curve through those points is one that was developed by an engineer by the name of Steinmetz, who is probably the most famous experimental engineer in the country. He is one of the experimental engineers for the General Electric Company, and one of the lines in which he has been very much interested is the mathematical side and the experimental side of electricity. Now, his idea is that, when you have a series of points such as this presented here, and wish to ~~pass~~ plot through them an average curve, as, for instance, if I plot points all around here in that fashion—Of course for rough work you can just size up by the eye what straight line will approximate the average of those points—and it would pass through in some such fashion as that. If, however, you want accurate results, the method recommended by Steinmetz is to divide these points approximately into equal lots, as it were, that is, into two lots containing approximately equal numbers of points at either side of a line which is approximately at right angles to the point, and the line should be—the type formula for a straight line is Y, and the formula is, Y equals AX plus B. Now, if it is necessary, before you plot that particular curve, to determine the coefficient A of the variable X, and the constant term, B.

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that is done by taking each one of these points to the left of your line separately, and substituting in the value of Y, which is the distance of the point upwards from this horizontal line, which we will say in this case is approximately 2, and substituting in also the corresponding value for X, which in this case would be 1, and we will then have this equation: 2 equals 1A plus B.

Now, if you repeat that for all the points at the left of that line—I will take one other point here for the purpose of illustration; suppose we take the point here, and the value of Y there would be approximately 2.2, and the value of X would be about 3—Of course all these numbers that I am approximating here are taken accurately and directly from the table of the curves—We would have then, for the second equation by which we hope to determine A and B, the equation: 2.2 equals 3A plus B.

Now, if we add together that series of equations, we get, 4.2 equals 4A plus B.

We now pass onto the other side of the line, and repeat the same method of treatment, and I will take two points over there; I will take 2, because this will throw a line in there with at least an average of what I have taken. We will take this point, in which case Y will equal approximately 4, and the equation will be, 4 equals 3.5A plus B, and for the point here we will have, 2.5 equals 5A plus B, and if we take these points together, we get the equation 6.5 equals 8.5A plus 2B.

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Now, by solving those equations we have now two independent equations in A and B, and it is a rule that if you have two independent equations and two unknowns, it is possible, by simultaneous solution of the two equations, to determine the two unknowns. You then go about this solution in this fashion: subtract one from the other, and you get 4.5A equals 2.3, or that A will be equal to $\frac{2.3}{4.5}$, which is easily turned into a decimal number.

Then, given that result, you get that B is equal to something over 1, which I will indicate by 1 plus. Then we go back to this equation and substitute the values of A, and we find that y ~~Ø~~ is equal to $\frac{2.3}{4.5}$ X plus 1 plus—that is, something larger than 1; I don't think it is necessary to go through the calculations. All those curves have been calculated through in that fashion; that is the equation and the correct equation for averaging the lines to those points, and it can then be plotted in the light of that equation in some such fashion as that.

Q. 5. THE COURT: What is the object in the end, to show the varying relations between these several factors?

A. Yes, sir, to show that the oil—

Q. 6. To show that there is some constant curve?

A. Absolutely, and it shows in all these charts, not only in regard to the dilution, ~~but in regard to the dilution,~~ but in regard to the percentage of sulphide.

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This is the line of the average when the percentage of sulphide was held practically constant, while some of these other curves were plotted when the dilution was held practically constant, and the only thing plotted were the percentage of sulphide and the amount of oil, and in those cases the same kind of an equation is shown.

Q. 7. Going right back to this exhibit 198,—I want to get onto these curves—On the 28th of September you have got a .99 copper, .93 iron and 12.79 solids?

A. Yes.

Q. 8. Now, you had less metal, so you must have had more water in the solution?

A. More water, yes.

Q. 9. And consequently your oil content runs pretty high?

A. Yes, sir.

Q. 10. Then if we take the one for the 6th, you have got ~~some~~ more copper and more iron and more solids?

A. Yes, sir.

Q. 11. That would mean of course less water?

A. Yes.

Q. 12. Your oil content runs down pretty low?

A. Yes.

Q. 13. It is a pretty wide variation, and this is an attempt to balance all these factors?

A. Yes, that is what I say. It is the same question here; it is the same problem which confronts the actuary. He has people dying, children, middle aged people, old people, dying at all ages, yet he balances